FEBRUARY 1934

INDUSTRIAL ARTS AND VOCATIONAL EDUCATION

SCHOOL SHOP
ANNUAL
EDITION·1934

The Bruce Publishing Company
New York Milwaukee Chicago

The Columbian Vise & Mfg. Co.

Cleveland, Ohio

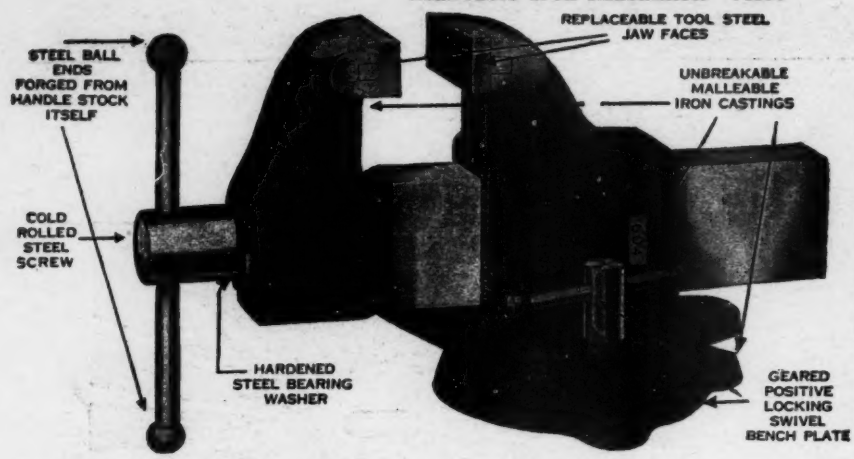
Manufacturers of

COLUMBIAN VISES and CLAMPS

COLUMBIAN VISES AND CLAMPS are standard equipment in schools and in industrial plants — wherever rugged dependability, accuracy and highest quality are demanded in service equipment.

The Columbian Line of Vises is complete and includes every style and size of vise used in metal and woodworking shops. They are sold by hardware and industrial supply distributors. Catalog upon request.

Malleable Iron Machinists' Vises


STEEL BALL ENDS FORGED FROM HANDLE STOCK ITSELF
COLD ROLLED STEEL SCREW
REPLACEABLE TOOL STEEL JAW FACES
UNBREAKABLE MALLEABLE IRON CASTINGS
HARDENED STEEL BEARING WASHER
GEARED POSITIVE LOCKING SWIVEL BENCH PLATE

Columbian Machinists' Vises embody the best features of design and construction to insure proper strength, accuracy, and durability.
Castings are made of malleable iron—guaranteed not to chip, crack or break.
Jaw Faces of tool steel dowelled into the jaws but replaceable when worn or damaged; gripping faces are knurled but can be furnished smooth, if desired.
Screws of best grade screw stock, oversize and carefully threaded.
Handles with forged ball-ends which cannot work loose or come off.
Nuts of malleable iron — extra heavy.
Bases are all flat, which makes cutting into bench for installation unnecessary.
Swivel type has positive locking mechanism which will not slip.
In addition to the popular styles listed below, vises with swivel back jaw, combination pipe vises and other models can be supplied—all Columbian quality.

Stationary Base Machinists' Vises

Vise No.	503	503½	504	504½	505	505½	506	507	508
Width Jaws	3"	3½"	4"	4½"	5"	5½"	6"	7"	8"
Jaws Open	4½"	5"	6"	7"	8"	9"	10"	12"	13"
Weight, lbs.	20	27	34	44	53	74	90	118	150

Swivel Base Machinists' Vises

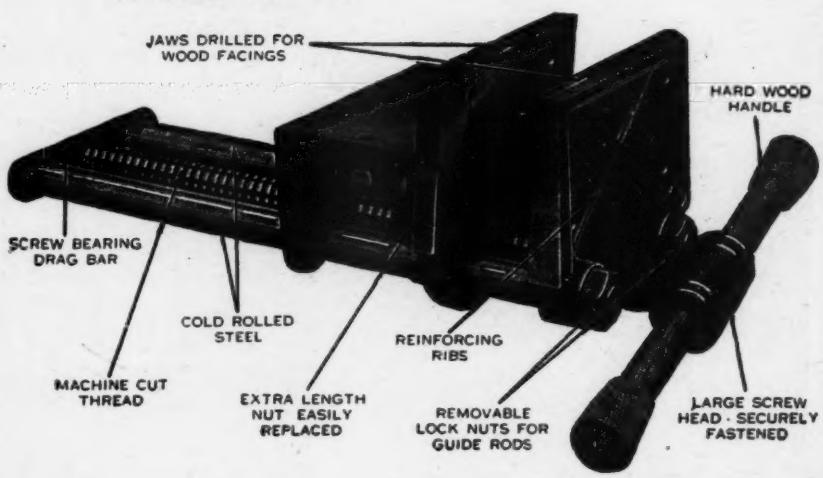
Vise No.	603	603½	604	604½	605	605½	606	607	608
Width Jaws	3"	3½"	4"	4½"	5"	5½"	6"	7"	8"
Jaws Open	4½"	5"	6"	7"	8"	9"	10"	12"	13"
Weight, lbs.	25	32	39	55	61	84	100	135	160

Woodworkers' Vises

Columbian Woodworkers' Vises are made in rapid-acting and continuous-screw styles. Both are simple in construction and efficient in operation.
Castings of heavy grey iron—the best for the purpose.
Jaw Faces are smooth and accurately finished. Have screw holes for installation of wood faces — these can be furnished at slight extra cost.
Screws are extra heavy with carefully cut double threads.
Handles of wood, straight grained and strong. See note below.
Nuts: Bronze half-nuts are used in the rapid-acting models; heavy malleable iron self-centering nuts are used in the continuous-screw models.

Special All-Steel Handles

can be furnished for continuous-screw models at slight extra cost. With this new handle these vises are practically as fast in operation as rapid-acting vises. They will last a lifetime.


JAWS DRILLED FOR WOOD FACINGS
HARD WOOD HANDLE
SCREW BEARING DRAG BAR
COLD ROLLED STEEL
REINFORCING RIBS
MACHINE CUT THREAD
EXTRA LENGTH NUT EASILY REPLACED
REMOVABLE LOCK NUTS FOR GUIDE RODS
LARGE SCREW HEAD · SECURELY FASTENED

Continuous-Screw Woodworkers' Vises

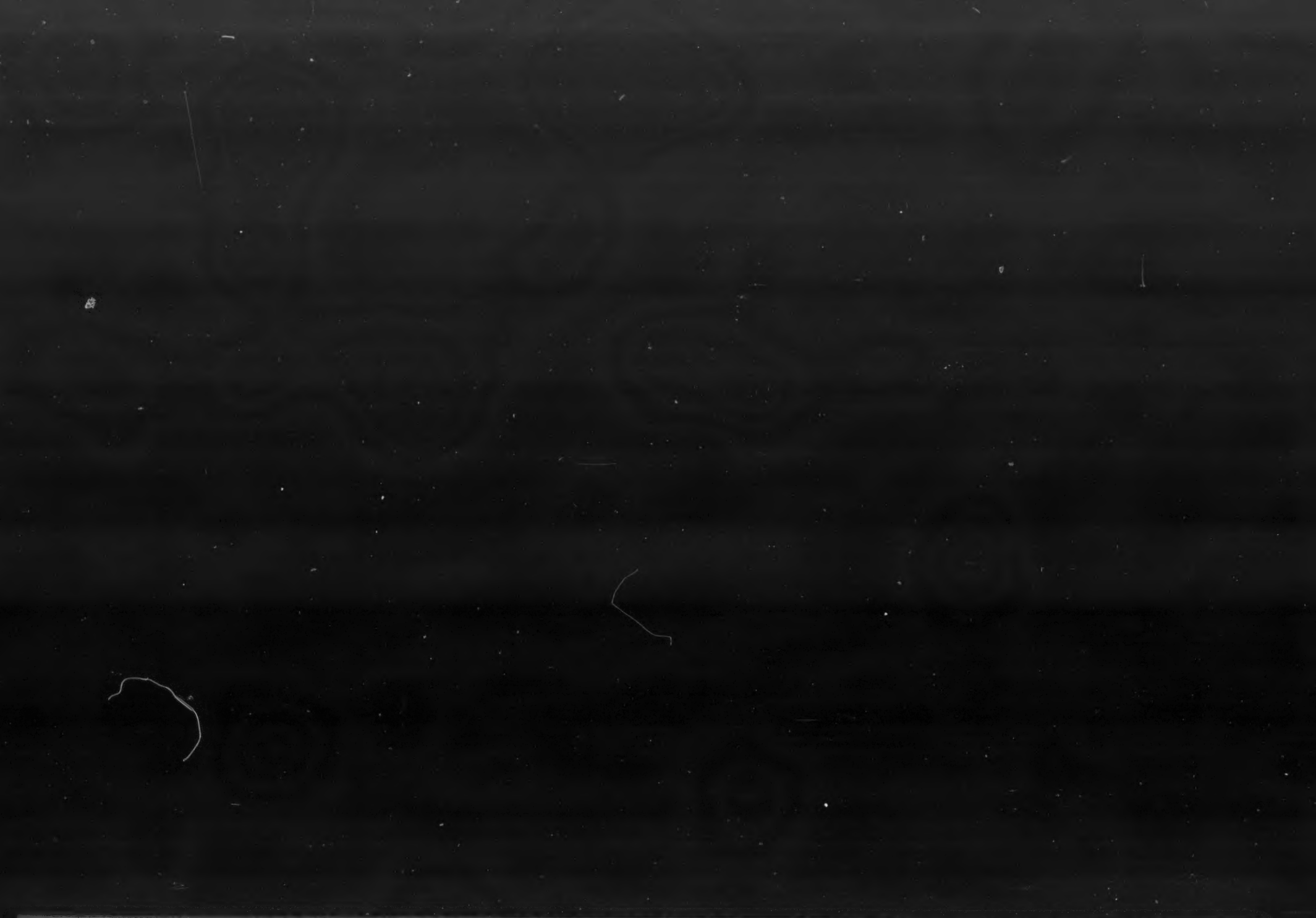
Vise No.	5 C	3 C	5 CD*	3 CD*
Size Jaws	4" x 7"	4" x 10"	4" x 7"	4" x 10"
Jaws Open	9"	12"	9"	12"
Weight, lbs.	22	30	23	31

*With dog in front jaw.

Rapid-Acting Woodworkers' Vises

Vise No.	1 R	9 R	1 RD*	9 RD*
Size Jaws	4" x 7"	4" x 10"	4" x 7"	4" x 10"
Jaws Open	9"	12"	9"	12"
Weight, lbs.	24	32	25	33

*With dog in front jaw.



The Carborundum Company

(Reg. U. S. Patent Office)

Niagara Falls, N. Y.

Manufacturers of

Abrasive Products for School Shop Work

Abrasives play an all-important part in school shop work. It is particularly desirable that the shops be completely equipped with fast, clean-cutting, durable sharpening stones, grinding wheels, and abrasive paper and cloth to meet all abrasive needs. The Carborundum Company has always made a feature of supplying abrasive products exactly suited to the conditions of the school shop.

Carborundum Brand Sharpening Stones

Carborundum Brand Sharpening Stones are also made in the solid grit—that is, the same grit all through. These can be used for exactly the same purposes as are the combination stones. They also cut clean and fast, show long life, wear evenly. Like the combination stones, they can be used dry or with oil. Made in fine, medium, or coarse grit.

No. 115—Fine.....8 x 2 x 1 inches
No. 116—Medium..8 x 2 x 1 inches
No. 117—Coarse....8 x 2 x 1 inches

No. 121—Fine.....6 x 2 x 1 inches
No. 122—Medium..6 x 2 x 1 inches
No. 123—Coarse....6 x 2 x 1 inches

Carborundum Brand Extra Hard, Extra Fine Stones

For giving a finer, smoother edge to woodworking and carving tools, these extra fine, extra hard stones have been developed. These include a special manual training slip stone for sharpening gouges, etc.

No. 156—8 x 2 x 1 inches
No. 158—6 x 2 x 1 inches

No. 172 Slip—4½ x 1¼ x ½–3/16 inches (Special Manual Training Slip)

Special Carborundum Brand Stones are also made for truing and sharpening of automatic planer knives. For sizes, etc., see catalog.

Carborundum Brand Combination Stones

For sharpening chisels, plane bits, scraper knives and similar edge tools, these combination stones are recommended. One side is in coarse grit to take out nicks and to bring the tool to an edge; the other side, fine grit to impart the keen, smooth edge. Made in seven sizes.

No. 108—8 x 2 x 1 inches.
No. 109—6 x 2 x 1 inches.
No. 110—7 x 2 x 1 inches.
No. 111—5 x 2 x ¾ inches.
No. 112—4 x 1¼ x 5/8 inches.
No. 328—8 x 3 x 1 inches.
No. 329—9 x 3 x 1½ inches.

Carborundum and Aloxite Brand Grinding Wheels

Reg. U. S. Pat. Off. Reg. U. S. Pat. Off.

Getting the right wheel in the right place is one of the first principles of grinding. For the grinding of materials of low tensile strength, such as brass, bronze, cast iron, etc., Carborundum Brand Wheels are recommended. For the grinding of high tensile strength materials, such as steels and alloys, Aloxite Brand Wheels should be used. These wheels are made in all necessary sizes, grits, and grades to meet all grinding conditions.

Carborundum Brand Coated Abrasives

The Carborundum Company is one of the leaders among the manufacturers of abrasive paper and cloth. These products include Carborundum Brand Garnet and Flint Papers for the finishing of all woods, and Aloxite Brand Cloth for the finishing of metals.

Carborundum Brand Garnet Paper

Where a paper coated with a harder abrasive for use on the harder woods or in cases where a more careful finish is desired, Carborundum Brand Garnet Paper should be used. Uniformly coated with accurately graded North River Garnet. Strong, durable yet flexible backing. Cuts free and clean. Supplied in 9x11 inch sheets, reams, and in standard rolls in standard grits.

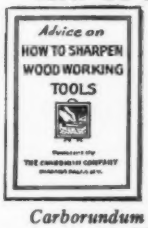
Carborundum Brand Flint Paper

On ordinary run of sanding, particularly on softer woods, Flint Paper can be effectively used. Carborundum Brand is uniformly coated with uniformly graded superior flints. It cuts clean, it's durable. Furnished in Handi-pac cartons, assorted grits or standard ream bundles.

Aloxite Brand Cloth

Aloxite Brand Cloth has long ago taken the place of the old slow-cutting emery cloth. Here is a cloth that cuts with far greater speed, leaves a more uniform finish. It is coated with the hard, sharp, tough grains of Aloxite Brand aluminum oxide—a manufactured abrasive. Aloxite Cloth is put up in standard ream packages 9 x 11 inch sheets or in economy rolls—see illustration.

How To Sharpen Woodworking Tools



A valuable booklet on How To Sharpen Woodworking Tools has been prepared by The Carborundum Company. This is a practical treatise on the subject written by an authority on school work. Copies of this illustrated booklet and the complete Carborundum catalog will be sent free upon request.

Carborundum and Aloxite are registered trade marks of The Carborundum Company.

The Carborundum Company, Niagara Falls, New York

"MONARCH"
Woodworking Machines

Particularly Adapted for Manual Training Schools

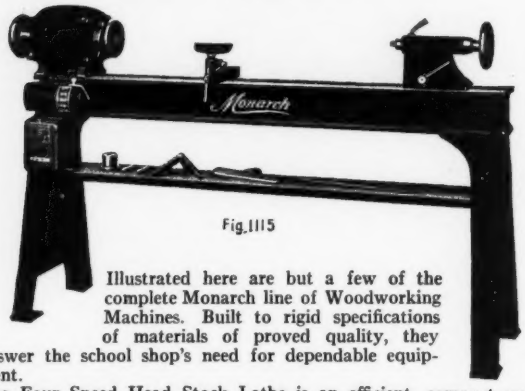


Fig.1115

Illustrated here are but a few of the complete Monarch line of Woodworking Machines. Built to rigid specifications of materials of proved quality, they answer the school shop's need for dependable equipment.

The Four Speed Head Stock Lathe is an efficient, compact and complete machine especially adaptable for manual training requirements. It has head stock fully enclosed, motor of ½ H.P. at low speed developing more power at higher speeds, four speed lever control and magnetic switch providing for overload and under-voltage protection, head stock spindles threaded at both ends for face plates, tail stock of box design and easily adjustable tool rest that swings to any angle. Specifications on request.

6" and 8" BENCH JOINTERS

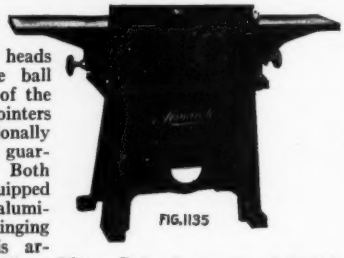
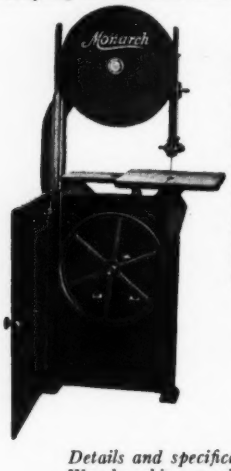


FIG.1135

These Jointers are made in six-inch and eight-inch sizes, with safety round heads that run in high grade ball bearings. They have all of the adjustments of large jointers and are built with exceptionally long, rigid tables and are guaranteed for close work. Both sizes are regularly equipped with rabbeting arms and aluminum guards of the swinging type. Either machine is arranged for Belt Drive or Direct Motor Drive by means of flexible Coupling or Shaftless Motor.

NO. 72 — 20" BAND SAW



Here is a band saw of the latest approved designs, built to meet the most rigid requirements of safety regulations. Every moving part is fully guarded, except the portion of saw blade in the cut. The UPPER WHEEL is mounted on ball bearings; the LOWER WHEEL is mounted directly on the motor shaft, allowing the maximum of power for useful work. Motors of ½, ¾ and 1 H.P. may be used and furnished for the following electric currents:

220, 440-volt, 2 and 3-phase, 60-cycle, 875 R.P.M.
550-volt, 3-phase, 60-cycle, 875 R.P.M.
550-volt, 3-phase, 25-cycle, 715 R.P.M.
220, 440-volt, 2 and 3-phase, 25-cycle, 715 R.P.M.
220, 440, 550-volt, 3-phase, 50-cycle, 970 R.P.M.
110, 220-volt, single-phase, 850 R.P.M.
115 or 230-volt direct current, 850 R.P.M.

Details and specifications on any other Monarch Woodworking machine in which you are interested will be furnished on request. Write.

American Saw Mill Machinery Co.
74 Main St., Hackettstown, N. J.

TRADE MARK
"Jorgensen"
REG U S PAT OFF

CLAMPS

There are Jorgenson Clamps for every job —clamps of all types and sizes that embody an excellence attained through a quarter century of specialization in CLAMPS.

Genuine Jorgensen Handscrews, the most widely used and "most poorly imitated" clamps made, take a firm grip on any shape; do not slip, or split; handles do not loosen.

Pony Clamp Fittings on ordinary pipe make clamps of any length. Low price, and range of uses recommend them for schools.

Jorgensen *High Speed* Steel Bar Clamps are standard in industry. Six types with patented clutches that "zipp" to position.

Jorgensen "C" Clamps are strictly speaking the finest made — Light, Medium and Heavy, Malleable and Drop Forged.

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Has served schoolmen for over a half century as a convenient and economical source of all

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A complete line of Cabinet Hardware also available.

Schoolmen have learned that they can buy safely and wisely at Lussky, White & Coolidge, with the result that every year an increasing number of Supervisors and Instructors ask us to quote on their complete tool and supply lists.

Get acquainted with our complete, comprehensive line by sending TODAY for our 290-page Catalog "J." No Cost — No Obligation.

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SAVES

Time - Money - Saws!

Many woodworking instructors have definitely ended all saw-filing problems and labor by using the Foley Automatic Saw Filer. Their students are being taught to operate the Foley, which does the work automatically.

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One Machine Files All Saws

—hand saws, band saws and cross-cut circular saws. Every tooth is automatically filed and jointed to exactly the same size and spacing. No eyestrain. Makes saws cut cleaner, faster, truer and stay sharp longer.

Used in hundreds of schools and woodworking plants throughout America. Every student should know how to operate a FOLEY. *Write us today for complete information.*

FOLEY MANUFACTURING COMPANY

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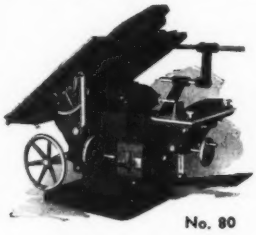
"Oliver" Woodworking Machinery



No. 80

One versatile number in our complete line of woodworking machinery is illustrated

The No. 80 Variety Saw Bench is designed and constructed to meet established "Oliver" high standards. It is speedy, accurate and economical. Furnished with plain or universal table. Rips, cuts, miters perfectly and, with attachment, bores and mortises. Equipped with the most advanced safety appliances. Compact. Ball bearing thruout. Belt or motor drive. Specifications on request.

Other machines in the complete "Oliver" line adapted for school shops include: Lathes, Jointers, Sanders, Boring Machines, Shapers, Jig Saws, Planers, Oilstone Tool Grinders, Band Saws, Tilting Saw Bench, Surfacers, Tenoner, Hollow Chisel Mortiser, Wood Trimmer, Vises and Glue Heaters.

Descriptive literature sent upon request

Oliver Machinery Company

Grand Rapids, Michigan, U.S.A.

HIGH GRADE MACHINERY

ATKINS SILVER STEEL SAWS

For Tomorrow's Craftsmen!

No. 401 Ship Point — SILVER STEEL — Straight Back

The aristocrat of hand saws . . . preferred in many schools for advanced students. Taper ground; with Improved Perfection Handle. Made to saw easily and dependably. Ship Point 26" only. Regular pattern 24" and 26". No. 400-same except skew back.

No. 65 Ship Point — SILVER STEEL — Straight Back

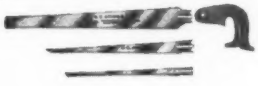
Husky and dependable, admirably suited to the wear and tear of student use. Taper ground; has Improved Perfection Handle. Ship Point 26" only. Regular pattern 20" to 26". For skew back saw of same specifications, order No. 53.

No. 2 Back Saw — Made of SILVER STEEL

As sturdy as they come . . . Made of famous SILVER STEEL; with seasoned applewood handle. Back of blued steel is exceptionally stiff and rigid. Made 8" to 18".

ATKINS Handy No. 3 Nest of Saws — SILVER STEEL

Nest includes Handle, adjustable to three different angles; 14" Compass; 12" Keyhole and 16" Metal Cutting Blades, all interchangeable. Metal Cutting Blade tempered exceedingly hard to cut nails, pipe or conduit. Is taper ground.

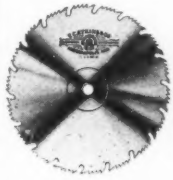


ATKINS "Easy-to-Use" No. 10 Hack Saw Frame

Easiest handling frame to be had. Handle of non-breakable hard rubber is attached so as to direct full force of stroke along cutting edge of blade. Nickeled frame also constructed to prevent injury to hands in case blade breaks. Adjustable for 8" to 12" blades.

Famous SILVER STEEL Hack Saw Blades

"BLUE END" Blades are justly popular everywhere because they do cut more metal, because they are the longest-lasting, fastest and easiest cutting blade on the market. Available for every type of hack saw cutting.



No. 37 Dual Ground Circular Saw

"Smoothest cutting saw"—say users everywhere. In fact, it makes glue joints directly from the saw (either cross-cutting, ripping or mitering) at 60 board feet per minute, 3600 r.p.m. 5" to 20" diam. for any standard machine.

Narrow Band Saws

A precision saw equal to the most delicate resawing jobs. Made of SILVER STEEL, durable and dependable. Available in widths from ⅛" to 1¾", any length, in coils or brazed ready for use.

ATKINS Professional Saw Service is yours for the asking. Write (on your SCHOOL LETTERHEAD) for information about text-books, films and other FREE educational matter on saws and their care for your classes.

TODAY'S CRAFTSMEN everywhere select ATKINS Saws and Saw Tools. Make sure that TOMORROW'S CRAFTSMEN — your students—have the right saws by insisting on ATKINS... If you can't get them locally, write to us at once.

E. C. ATKINS AND COMPANY

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The R. L. Carter Company

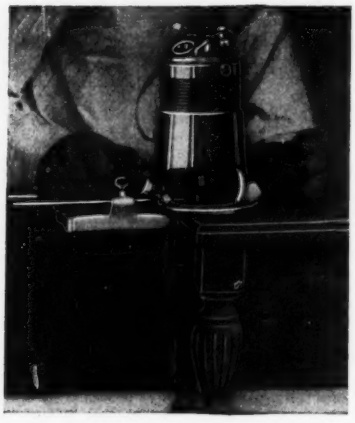
New Britain, Conn.

Manufacturers of

Routers, Hand Shapers and Grinders

Every woodworking project is made more attractive,instructive and enjoyable when Carter Electric Hand Tools are used. Give your boys the advantage of using the same electrical tools that are universally used in the trade—Send for Catalogues illustrating all of the Carter Routers and Shapers — get the complete story on these safe, versatile and economical tools.

Carter R4 — 3/8 H.P. Router



With this Router you can cut out inlays and do your own inlaying; cut mortises, tenons, half laps and dovetail joints; make drop leaf cuts, table thumb mold cuts, rabbet, dado and spline cuts, do veining, beading, fluting, paneling, etc., because this machine can be accurately adjusted for depth of cut to 1/100th of an inch.

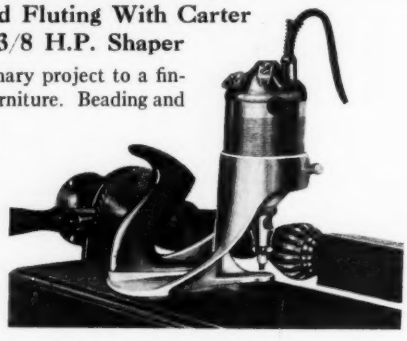
Carter R5A — 1 H.P. Router

Will do all that the R4 Router will do and because of its greater power can be used for heavier cuts.

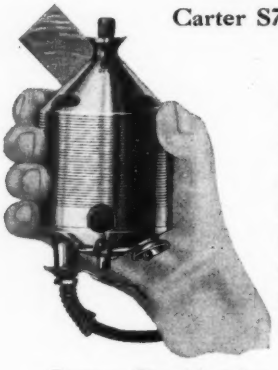
Features: Powerful motor, direct drive (no belts or pulleys), high speed (17,000 R.P.M.), oversize oil sealed bearings, accurate depth adjustment, light weight and low center of gravity, built to last.

Beading and Fluting With Carter S4 — 3/8 H.P. Shaper

Converts an ordinary project to a finished piece of furniture. Beading and fluting with this equipment is easy; it assures smooth work without sanding, and it is performed with absolute safety to the operator.

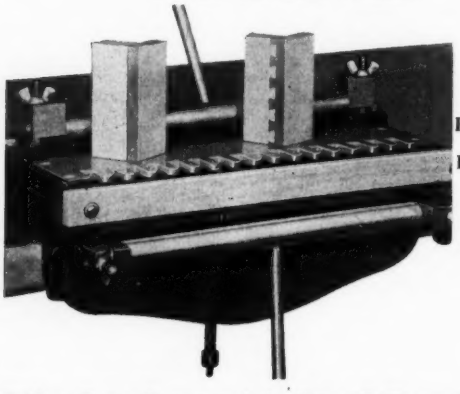


Carter S7 — 1/7 H.P. Hand Shaper



Because of its light weight and small diameter (only 3"), it is the ideal tool to make corner cuts such as beads, chamfers, rounds, etc., after the work is assembled. In combination with Carter Attachments it will do countless jobs no other machine can touch.

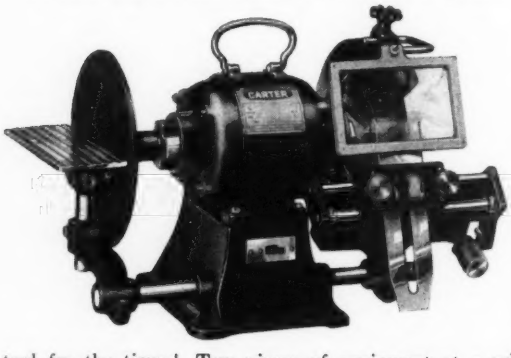
Carter Dovetail Fixture



Used with R4—3/8 H.P. or R5A—1 H.P. Router to cut Blind and Open Dovetails

With a Carter Router and the Dovetail Fixture both pieces (front and side) of a joint are completed in one pass across the work. Takes pieces up to 13" in width. Average cutting time for two pieces is one minute. This is but one of the useful attachments for Carter Routers.

Carter Combination Sander and Grinder



A tool for the times! Two pieces of equipment at a price only slightly more than you would pay for either one. Features: Plane iron and chisel grinding attachment, sanitary eye shields of non-shatterable glass, sanding table adjustable for height and angle

The R. L. Carter Company, 106 Elm Street, New Britain, Conn.

INDUSTRIAL ARTS and VOCATIONAL EDUCATION

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Bruce's School Shop Annual

The February issue of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION again appears in company with BRUCE'S SCHOOL SHOP ANNUAL. As in former years, the ANNUAL presents much authoritative material on shop planning, shop equipping, shop management, shop courses, and shop layouts.

Outstanding among the articles appearing in this, the seventh edition of BRUCE'S SCHOOL SHOP ANNUAL, are Dr. Warner's "Studies in School-Shop Planning" and Prof. Hunter's "Principles of Shop Planning." A. C. Tagg's "Industrial Education at Fordson" also contains much informative and helpful material.

In order to make the ANNUAL as helpful as possible to every type of reader, the problems and projects chosen for this issue of the INDUSTRIAL ARTS AND VOCATIONAL EDUCATION Magazine are largely of the shop utility type. For this same reason the equipment, material, and supply lists, and the manufacturers' products lists, found so helpful in former editions, again have been included.

Articles Indexed—The articles contained in the Magazine are regularly indexed in "The Reader's Guide to Periodical Literature," and "Education Index."

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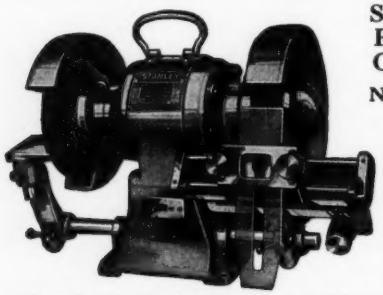

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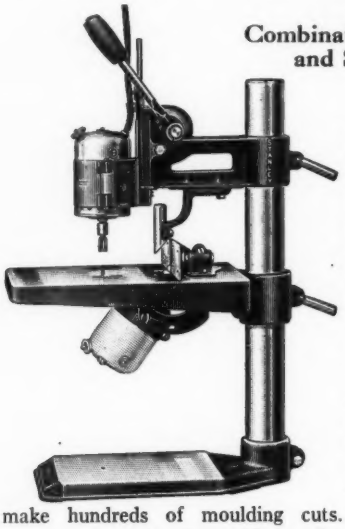

Uses the same power unit for all kinds of bench routing, mortising, flat turning, etc. By using simple templets intricate designs can be easily duplicated on wood. Illustration also indicates how the motor can be transferred to the holder under the table and used as a shaper. This holder can be tilted 45° so that it requires but 3 or 4 cutters in various combinations to make hundreds of moulding cuts. Other uses — tongue, groove, core, chamfer, rabbet and many, many other cuts.

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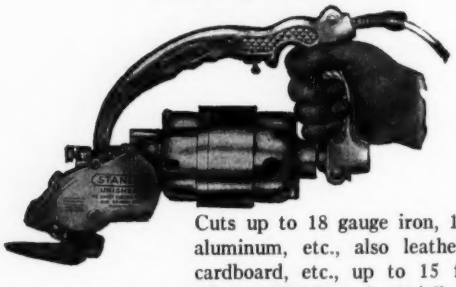

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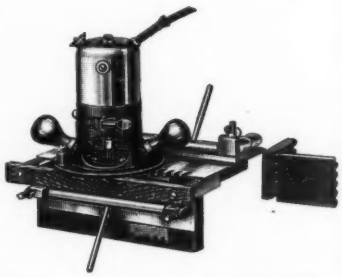

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Studies in School-Shop Planning

William E. Warner

The Ohio State University,
Columbus Ohio

A summary of certain phases of a school-shop-planning investigation begun in 1932 under the author's direction.[1] While the study emphasizes school-shop planning from the industrial-arts angle, yet the discussion is applicable equally to shop planning for vocational purposes.

THE general movement since the world war to enrich both the nature and range of the industrial-arts field has made the resulting problems of school-shop planning more complex than ever before. With complexity comes inevitable confusion unless some way is found to objectify and organize the many problems involved. Clues for the solution are to be found on every hand.

Many valuable suggestions are to be gained from industry: the development of production units or lines, wide aisles, central toolrooms, the development of production departments, timekeepers' desks, and the like, are common. The school-shop problem, however, is one to conjecture upon by the profession, as architects still do almost all of the planning.

Shop teachers are confronted with a number of forces from which they need protection in the planning of shops. These include customs, architects, school executives, manufacturers, school boards, the public, legislatures, and particularly themselves. All of these forces produce ideas, many of which have proved to be excellent, but the profession still needs a formulation of technique of school-shop planning less subjective and more objective. With this brief introduction, then, it may be possible to list some of the studies which seem to lie back of the problem.

Professional Considerations

Several thoughts suggest themselves. It ought to be clear, for example, that any plan should strive to build for a valid program of education, while at the same time trying for a practical ideal in terms of the example of industry. Yet frequently the school requires variations from the example of industry, such as in the arrangement of benches, bench heights, and types of machines chosen.

The small school is naturally handicapped because of size and cost items, whereas the large school is generally favored because of these items. One is confronted, then, with developing his studies in school-shop planning to fit both a minimum and an optimum plan. Furthermore, should a shop development be any different in Maine from what it is in Arizona, or any different in one type of locality (e.g., in a community which is largely industrial) from what it is in another (e.g., one where agriculture predominates)?

As various other shop units besides the traditional ones of woodworking and drawing are developed, one is confronted with the problem of keeping all of the areas or units balanced. Is there any reason, for example, why a traditional unit should be twice or three times the size of a textiles, metals, electrical, or ceramics unit. This invariably happens, not only because a particular unit is traditional, but because the teacher or supervisor in question may know that phase of his work better than some of the others.

Questions of time allotment,[2] teaching load, and class size also are important problems which influence whatever kind or size of shop is planned. With larger shops, particularly those involving more than one teacher, it frequently seems as if the related problems of organizations multiply in geometric proportion.

The student of planning will find several approaches to the solution of his problem. These include a review of local, state, and national conditions which influence such things as buildings, lighting, ventilation, and the like. He will also have at his disposal professional objectives which he should use as criteria for any step taken. Exploration, for example, would require the development of balanced areas, whereas the old-time "manual training" purpose of manipulation alone would, no doubt, be quite well satisfied with a much more limited range of industrial types.

Many facts can be had from industry itself and from various research bureaus, such as the United States Bureau of Standards. The opinions of specialists may be sought, and a very elementary type of study can be made by anyone who cares to conduct a series of such frequent studies as, noting the occurrence of use of certain items such as a block plane, a turning saw, a micrometer, a generator, or a hydrometer, before any one of these items of equipment is purchased in quantity. Studies of frequency may also be made regarding the use of certain more permanent items, such as the jointer or band saw, to determine how it would best be placed with respect to the other machinery.

Certain Initial Procedures

In line with the above it is now possible to suggest some very specific approaches to the study of school-shop planning. The importance of these will be readily appreciated as they are enumerated, and because of space limitations they are presented without discussion.

The School and Community Survey. (1) Number of pupils by grades; (2) likely rate of increase or decrease of the school community over a period of years; (3) social-economic character of the school population; (4) psychological character of the school population; (5) nature and extent of local industries and businesses; (6) nature and extent of other technical school installations; (7) general attitude of the community toward its program of public education; (8) dis-

[1]References in this study acknowledge the fine contributions made to the study by Erick Berglund, of Ely, Minn.; Elroy W. Bollinger, of Grand Forks, N. Dak.; William R. Fiedler, of Worcester, Mass.; John E. Fintz, of Cleveland, Ohio; DeWitt Hunt, of Stillwater, Okla.; Burl N. Osburn, of Millersville, Pa.; Glenn L. Roberts, of Smithfield, Ohio; Rudolph L. Schwanzle, of Emporia Kans.; Orville E. Sink, of Muncie, Ind., and Willis A. Whitehead, of Dunbar, W. Va.

[2]See the study made by Maris M. Proffitt in the United States Office of Education.

covery and use of channels of organization in the community which would affect the shop plan; (9) the financial situation.

Preparing an Industrial-Arts Program. Surely it is well understood that no shop plan can be considered valid unless it is backed by a preliminary study and formulation of a curriculum, and back of that lies the formulation and presentation of a set of valid professional objectives as a basis for the curriculum. These objectives will naturally be influenced but not dominated by the school and community survey.

One of the first outcomes of all these approaches should be a tentative laboratory layout which would show provisions for the achievement of many of the questions raised concerning community applications, pupil applications, staff requirements, ultimate development factors, cost factors, organization factors, and the like.

Only the most mature study of problems like these will give one sufficient background for approaching the study of school-shop planning. Various sections of a state and various sections of the country do things in different ways, and one can easily be led astray unless he has given the various problems broad study. Nine main groups of technical researches are seen as making up such a study. An enumeration of these follows.

Questions of Shop Location

This topic is seen to divide itself into four parts; namely, place, floor level, accessibility, and orientation, or direction of face.

Place. Shops may be found in any number of places. They are frequently found in basements, and one bit of existing state legislation intimates that that is where they should be placed. It is customary in the Southwest, for example, to find shops placed in separate buildings, frequently at the very back of the school lot. Is this the thing, and are the arguments for such isolation because of dirt and noise more valid than the principle of integration in education, which requires a much more intimate tie-up with shopwork than is possible in a separate building? One needs to answer these professional principles before he can arrive at the solution of the problem of the best location for any given shop. The following list is presented in the order of preference and assumes the answers to many professional questions: (1) wing of building (considered most desirable); (2) center of building, as, for example, on the ground floor under an auditorium; (3) separate building attached to the main building; (4) entirely separate building; (5) portable structure (considered least desirable).

Floor Level. Here again a list of suggestions is presented in the order of their preference. (1) First floor, or street level (the rule usually followed is to place the shop floor one step above the grade level); (2) partial basement; (3) second floor; (4) total basement with area ways; (5) third floor or above; (6) total basement without area ways (least desirable).

Accessibility. There are two phases of the problem of accessibility, one of which concerns the outside of the building and the other the rest of the school. Outside doors should open on to driveways if possible, and if a ramp is involved, it too should lead to a driveway. The Connelley Trade School in Pittsburgh, for example, has a freight elevator which leads directly to a street and connects every floor of the building, the halls of which may be used as driveways. A single-door exit to the outside of the building is not so desirable as a double door, and no exit at all is least desirable. The Stout Institute, in its carpentry shop, for example, is able to open one side of the industries building to provide for the removal of a garage or small house which students are able to start inside the shop. Sowers, in Miami, Florida, describes a similar arrangement in connection with a shipbuilding shop.

One of the most important considerations concerning the question of accessibility to the rest of the school concerns the main and secondary exits. The main exit should open on to a principal corridor, whereas the secondary exit might well open on to a stairway.

Large shops, such as the Norwood, Ohio, development (60 by 118 ft.), would do well to provide toilet facilities, but in smaller shops this is not advisable. The rule followed, however, is to place toilets within fifty paces from a shop exit. The national code requires individual toilet units for every sixteen pupils, but studies made by the housing division in Cleveland reveal that the number of pupils accommodated can be several times larger than that, even up to 100.

The centralization of all shop rooms is an important problem and would seem to extend from that of a single allocation on the same floor, as the most desirable, to the placement of units in different buildings, as the least desirable. The Collinwood High School in Cleveland, which houses some 5,000 pupils, has placed its centralization of shop rooms on several floors of one wing of the building, which, no doubt, is the most feasible method for developing the large program under way there. Angelo Patri's junior high school of 4,500 pupils in New York City, however, is housed in an old building where the shops are scattered.

The question of interdepartmental relationships arises. Surely art and home economics should be adjacent to any industrial-arts development, and it would be difficult to understand how any broad program of commercial work could be very effective if it were separated too far from an equally progressive printing development. The school library is assumed to be central to all of the school, which would make it easily accessible to the shops. The question of storage also enters into the problem of accessibility. As large storage space for both materials and projects is frequently needed, the best place for it, obviously, is in the basement. Still another problem of accessibility concerns various service features. It is exasperating to have to run to another building or even to another floor if one wants hot and cold water, or a stove, or a certain type of electricity.

Orientation (Direction of Face). Drawing teachers have agreed for a number of years on the principle that their rooms should have north light. This custom is seen to be no longer valid if one will go into problems of natural versus artificial light. There are very few places in the United States where natural light is to be depended upon at all times of the year for use in drawing. Artificial light is infinitely more desirable because it can be controlled equally well at all periods of the day and all seasons of the year, and one soon concludes that it doesn't make any difference which way a shop or drawing room faces, as long as the artificial lighting installation is correct.

Hetrick, of Akron, Ohio, despite custom and the existence of state codes to the contrary, has even gone so far as to propose several splendid shops without any windows at all. Ample precedent for this is seen in the Simonds Saw Company at Fitchburg, Massachusetts; if one is repelled by the thought, he should think of this point the next time he attends a theater. One occasionally finds an artificial window in a public building, placed there purely for psychological or decorative effect. There is an advantage, of course, in having more wall space, which cannot be had in shops or laboratories where the space is given over to windows. The custom, however, as regards orientation is to prefer a corner room, failing that, a bilateral room, on down to a room with windows along one side, and least desirable, a court or basement room.

Questions of Shop Size and Shape

No two shop men will likely be able to get together over some of the points listed in this technical part of the article unless they have answered some of the problems regarding school-shop planning which were raised in the introductory

part. This point is particularly true when one considers questions of size and shape.

Ratios of Width to Length. The general rule followed is to keep shops within a ratio of 1:1 up to 1:2 as regards width to length. The Ohio State University's new high-school laboratory is 44 by 77 feet, which makes the ratio 1:1¾. The Norwood installation is slightly less than 1:2. However, the writer teaches in a shop built before the war, which measures 23 by 106 feet, which gives the ratio of 1 to over 4½. This illustrates the principle that in order to keep within the two limits cited it is necessary to widen a shop as the area is made greater. This is easy of accomplishment if the architect can be led to see the advantage of combining corridor space with room space or of using a gymnasium size, or of using bays. The new Laboratory of Industries at Ohio State University, for example, cuts across two 24-foot classroom widths plus a corridor width of 12 feet and a bay of 17 feet to make a shop 77 feet long. The installation is on the ground floor with a swimming pool underneath and a gymnasium overhead. The Norwood installation, on the ground floor, gets its 60 feet of width by combining two 24-foot classroom widths and a hall of 12 feet. Its 118 feet of length is the full length of the wing of the building where it is located.

Square Feet per Pupil. It is interesting to figure the area of a shop and divide it by the number of pupils found there at any one time. A study was made on this point at Greeley, Colorado, some time ago, and reported in the pages of this magazine. The data were gathered west of the Mississippi River, and it was found that the median number of square feet per pupil was something like 66. This number is not at all typical of some of the school shops found in larger cities east of the Mississippi, where it is common to find between 30 and 40 square feet per pupil. One cites as a minimum, however, 50 square feet and is happier if he can have 75, which is labeled as the most desirable situation. Exceptions, however, are noted in such situations as shipbuilding, automotive repairing, carpentry, and other such units which, because of their very nature, involve more space. More than 75 square feet per pupil would seem to be unusual, however, and less than 40 makes for overcrowding.

Height. Shop men usually require rooms of greater height than is required by the academic classroom. The same is true for music rooms, gymnasiums, auditoriums, and libraries; whereas home-economics installations, particularly as regards the model apartment, require rooms of less height, more nearly approximating the situation in a home. The architect may balk at providing more ceiling height for shops unless he is led to see how easy it is to make this possible simply by dropping the floor one or more tread heights. The Ohio State University's new laboratory, for example, is made 21 inches higher by dropping the floor three tread heights. The same is true at Norwood, and it is concluded that ceiling heights of 12 to 15 feet for shops are most desirable. Anything less or greater than that would seem to be abnormal. Exceptions, of course, are noted in the foundry, where still greater height is frequently needed, or in a plumbing shop, where examples may be seen two to four stories high, in carpentry shops, where two-story heights are desirable, and frequently in electrical as well as in shipbuilding shops, where greater heights are desirable.

Shapes. DeWitt Hunt, writing in 1931, reported many different shapes for shops; as, for example, E, H, U, or L, and so on. There seems to be little excuse for anything other than an oblong shape unless the irregularities are used for auxiliary purposes.

Questions Regarding the Principal Units

Many studies in content and method, in addition to those already completed, will have to be made before it will be possible to describe just what ought to be included by way of various industrial representations in the industrial-arts program. Provision for automotives, for example, would be quite different if approached from the angle of automotive repair than it would be if approached from the angle of the consumer and general education, where it is conceivable that considerable testing and inspecting would be done. The question here, however, is to review the problems in planning which would help one determine if automotives, ceramics, drawing, woodworking, or any other representative phase of industry, should be included in the secondary school.

Caswell (4)[3] has completed a study on this problem, which has served principally to open up some of the questions involved. Approaches are seen in analyses made of the concepts which lie back of valid industrial-arts objectives, in an inspection of census data, in consumer studies, in an analysis of common manipulative abilities, in an analysis of constructive interests, in an analysis of industrial organization and management, in an analysis of production and merchandising methods, and so on.

Traditional equipment units found in school-shop situations include automotives, ceramics, drawing, electricity, general finishing, metal working (including forging, foundry, machine shop, sheet metal), woodworking (including patternmaking, carpentry, bench woodwork, and millwork), printing (including paper making, letter-press work, and bookbinding), and, in certain sections, both textiles and foods units.

It seems obvious that any manipulative work must include reference and drawing facilities, as has been introduced already in the idea of providing for a *planning center* which will not only accommodate studies to be interpreted in the laboratory, but investigational work as well.

The question also arises regarding which unit should be placed nearest the main exit and which farthest away from it. A planning room, for example, should be placed near both the main exit and the instructor's office, and a ceramic or foundry unit farthest away in a Laboratory of Industries setting. Any colorful or attractive unit is also better suited to a location near a principal exit than one less interesting and more inclined to involve sand, plaster, clay, and the like, which can be tracked out of the unit in question. There is also the problem of grouping various teaching units together which are to be handled by the same teacher, as well as grouping those which are closely related in their use of equipment, as, for example, sheet metal, "art" metal, forging, and foundry. Secondary schools of 1,500 pupils and larger find it administratively expedient to have mature unit-shop developments, but even then the idea of a Laboratory of Industries setting as a vestibule, including many of the units described above, seems to be most sound.

Questions Regarding Auxiliary Facilities

An auxiliary facility might well be defined as a necessary adjunct to the efficient operation of any school shop, but not so important a phase of its operation as to be considered on a par with the various shop units. Questions of *presence, location, adequacy,* and *convenience* concern every one of the following instances of shop auxiliaries: (1) instructor's office, (2) planning center, (3) tools, (4) supplies, (5) photography and blue-printing, (6) first aid, (7) storage, (8) lockers, (9) lavatory, (10) demonstration, (11) toilet, (12) finishing, (13) gluing, (14) ceramic stock, (15) kiln, (16) damp cabinet, (17) drying booth, (18) display or show case.

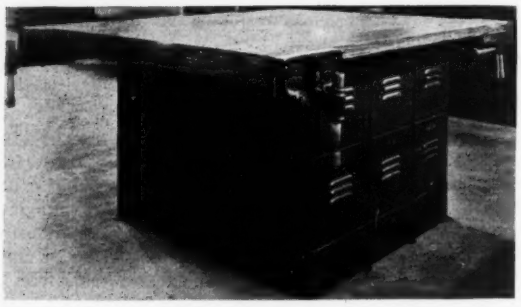
It is an old rule that toolrooms should be centrally located, either in the middle of the long wall or in the center of a shop, as at Norwood. Toolrooms are of the wall or counter type. The counter type is used when the toolroom is in the center where it must be approached from all sides and in such cases is most convenient if built of *pacpanel* steel 42 inches from the floor, plate glass 42 inches above that, and

[3]Figures in parentheses following a name refer to the numbers in the Bibliography.

steel the rest of the way to the ceiling. The wall type is employed in long, narrow toolrooms that are placed on or in a side wall, and may run to any convenient height if ladder facilities are provided. The open tool board is not favored because of its administrative inconvenience in the Personnel Organization.

Supply and storage rooms are frequently placed in basements, across halls, in rooms without windows, or in similar places where the space is usually not considered so valuable as that of classroom areas. Photography and blue-printing facilities are to be found in many places, usually where most convenient as regards washing and lighting facilities. The first-aid cabinet is one of the most important auxiliaries and should be found, therefore, centrally located, either as a part of the planning room or of the toolroom, and near a washing unit.

The Norwood plan includes steel bench bodies wherever benches occur throughout the entire laboratory. These bench bodies house steel lockers 1 foot wide, 15 inches high, and 2 feet deep. There are approximately 500 of them to be found in the laboratory. The University High School previously mentioned includes a similar arrangement and some 200 are to be found in this laboratory, occupying no more space than is needed for the benches, and making for a splendid-appearing laboratory.

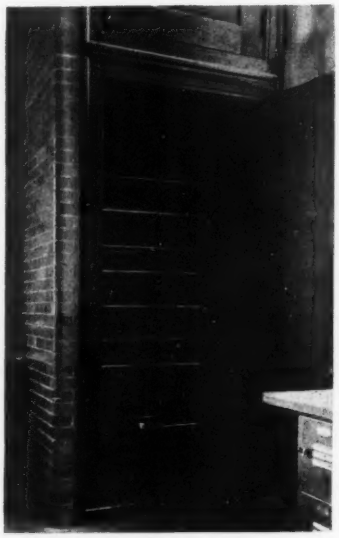


General woodworking bench, 32" high. Flat maple top 2" x 4'3" x 5'4". Steel body, 2'7" x 2'10". Six lockers on a side. Four rapid-action vises

Examples of wash fountains, sinks, or individual lavatories may be found in American school shops. Any one of these types may be operated with success. There is little excuse, however, in their administration, for not having clean washing units or for using them for other purposes than that for which they were intended. A washing facility, for example, is not meant to be used for plaster and clay purposes and vice versa.

Some feel, as in Detroit and Toledo, that a lecture-demonstration center should be in the form of a permanently installed amphitheater unit in every shop or laboratory. In this case the unit stands idle a major portion of the time and may be questioned from the administrative viewpoint if from no other. A better plan seems to be that of providing folding chairs to be stored in the toolroom and which can be brought out and placed at any location in a laboratory where a demonstration needs to be made. There is need, in connection with large laboratory developments employing two or more teachers, to provide for either planning or classroom facilities. Further studies and experiments in this connection might reveal valuable data.

Ceramic center at Norwood. Unfinished wood top, Alberene stone sink, plaster trap



Damp cabinet at Norwood. Three inches of water in basin at bottom. Brass rods serve as shelves

Experience has now been had with ceramic kiln installations both in the laboratory and elsewhere. The firing of a kiln seems to be just as interesting and instructive as the operation of any other piece of equipment, and if it is well insulated and the room is properly ventilated, it will not be too hot to be housed directly in the laboratory or preferably in an adjacent room.

The provision for a museum, show case, or display place seems to hold increasing importance for industrial-arts settings. One shop teacher reports some 8,000 pupils to have seen his lighted show case, even in a basement corridor, over the period of one week. The building of show cases in principal corridor walls seems to be more desirable, at least from the angle of merchandising one's shop program, than placing them inside the shop room. The show case should be equipped with vertical rows instead of horizontal showcase lights. This provides for a maximum of visibility. The back walls are best made of cork linoleum and the shelves of plate glass supported by movable brackets.

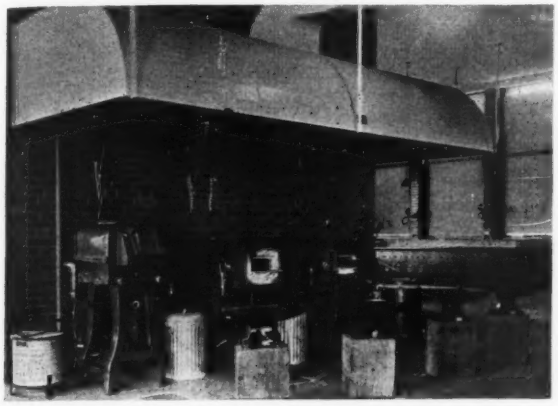
Questions Regarding Equipment Provisions

Many problems arise in connection with the equipment of every principal unit and auxiliary facility. One needs to determine what equipment items are needed in each subject-matter unit for a minimum class size of 4, 6, 8, 12, or more pupils; and further, if the particular equipment planned is suitable for all present and future requirements, if its quality is satisfactory, if the various items are located correctly with respect to other units, and if the nature of the installation makes for safety. Many thoughts will occur to the experienced shop teacher as he considers the answers from his own experience to these five groups of questions as they concern his own principal units.

The tendency seems to be toward smaller, better-designed equipment, which allows the school to use its more limited funds to spread over a wider range of installation. Ceramic

kilns for public schools, for example, may be bought at prices ranging from $15 to $1,000. A $300 kiln might be more expensive than a $600 one if it was not exactly suited to the purpose for which it would be used by pupils. The height of a circular-saw table might make it unsuited to the use of ninth-grade boys, regardless of its cost or adaptability.

New developments in finishing have occurred, both as regards the finishes themselves and as regards the hood



Metallurgical center at Norwood. Heat treatment furnace, forges, and crucible furnace all with individual blowers. Note the hood

arrangement for drawing off vapors, while the very nature of natural gas in certain communities where it is used for forging, melting, and heat-treating purposes, makes it very annoying for use in connection with a triple-purpose furnace without a hood. There are other situations where it is possible, although not entirely desirable, to install such a unit without a hood arrangement.

The question of the installation of the printing unit is of interest. The American Type Founders Company, for example, has long maintained a service for assisting schools to plan equipment for a printing room. The placement of a press, for example, needs to be made so the light will come from the left and so the press feeder, particularly if he is an amateur, will not be annoyed by anyone passing close to or exactly behind him. If the field of printing is to be enriched, then greater consideration will need to be given to problems concerning what type faces one should purchase for an installation. The tendency of the writer has been toward investing in several type faces rather than in one or two — all for the purpose of providing greater opportunity for creative design in connection with the graphic arts. There is every justification, as stated above, for the inclusion of planograph and intaglio units as well as paper-making, bookbinding, and letter-press units in the printing area.

Questions Regarding Building Details

Willis A. Whitehead, a graduate architect with a master's degree in industrial-arts education, has developed the principal research made on this particular phase of school-shop planning. It includes questions regarding floors, walls, partitions, columns, ceilings, windows, doors, blackboards, bulletin boards, show cases, mezzanines and balconies, driveways and ramps, and special flues. The research on shop floors is now completed.

Whereas the architect may feel that building details are entirely within his province, Whitehead points out that such details are in direct contact with the teaching situation involved in a school shop and cannot escape having a bearing upon the educational outcomes of the setting. Little attention has been given to providing for structural safety, beauty, and sometimes sanitation, as regards building details.

Following an industrial criterion, Ittner (6), as an architect, has already gone on record in correspondence as seeing little need for any finish on rough brick or tile walls in a school-shop setting. It would seem, however, that if a teaching situation is to be provided, there is definite need for acoustical treatment of walls, ceilings, and floors, and for a color scheme which will provide adequate lighting, as well as a pleasing environment.

One does not need much experience in shop teaching, according to Whitehead, before he concludes that the floor is one of the most important parts of his shop. He stands and walks on it all day long; materials are transported over its surface; danger is involved if it becomes too slippery; its wearing surface must be designed to endure; repairs are expensive; it must be insulated sufficiently well to be quiet and to prevent transmission of noise to other parts of the building; and must not be so hard as to cause tools to break which are dropped on it, or of such a nature as to cause foot troubles.

Whitehead's studies have encompassed an inspection of existing literature, correspondence with professional organizations and governmental departments regarding tests and opinions, the interviewing of experts, particularly on flooring, and the analysis of manufacturers' data. He reveals that researches are available which definitely prove nonresilient floors to be detrimental to health. Instances are cited which point to the confinement of individuals in hospitals due to standing for long periods of time on nonresilient floors. Whitehead quotes the United States Bureau of Standards to the effect that the end-grained block type is best suited for use in woodworking,

Metals area at Norwood

printing, electricity, and other shops of this nature. Such blocks should be laid by either "lateral nailing" or by the use of an odorless "mastic" compound. Individual blocks should contain eight or more "annual rings" per inch and should be treated with an odorless oil or paraffin. This type of flooring presents

Double molding bench at Norwood. Note grouping of pipes at left cabinet for flasks and riddles on right. Bench accommodates ten boys, five on a side

a pleasing appearance and is commonly found in the better designed and built gymnasiums.

Another type of floor found by Whitehead is known as a "wood block" (not end-grain) floor, which is used with satisfactory results in several of the newer post offices throughout the country. It is laid in patent mastic composition supplied by the manufacturer and gives most satisfactory service. This composition is odorless and adds great resiliency to the floor. Surely there is no question any more regarding the laying of these special floors. An early experience with permitting boys to lay an end-grain floor in a certain Kansas school proved to be most unsatisfactory.

Drawing, art, and office units require an entirely different kind of floor from shops. A quiet, resilient floor is needed, such as may be supplied by cork tile, rubber tile, and mastic tile. Cork carpet also offers a possibility. None of these floors, however, should be used directly on the ground, as moisture will cause them to warp and pucker which renders them entirely unsatisfactory.

Foundry and forging units present still another situation. In these areas the floor must be noncombustible and must prevent the spread of molten metal in case any is spilled. Either a dirt or cement floor is thought to be best in these cases. The dirt floor should be the first choice in case of the foundry because of the safety factor and its greater resiliency. While brick floors are sometimes found in forging shops, their use as a shop floor seems to be unsuited for school settings.

An interesting finish for floors is reported by Whitehead which *penetrates* the wood rather than forming a surface coat and results in a lustrous, hard finish, which may be left dull for shop settings.

Although his study is not complete on walls, Whitehead recommends the use of a dull-glazed brick up five feet from the floor, with an acoustical or soft plaster from that point on up to and including the ceiling. This type of wall and ceiling construction provides not only for cleanliness and good appearance, but for a quiet shop as well and may be seen in the University High School previously mentioned.

Steel, glass, tile, brick, wood, and combinations of solid, movable, partial, and railing partitions may be found. The individual situation will determine what kind of partition should be installed. The pacpanel (Globe-Wernicke) type of partition is favored. This gives insulation against dirt and noise, yet remains an integral part of the shop plan. This particular type of partition has been used in the Laboratory of Industries both at Norwood and at Columbus, Ohio.

Steel sash are preferred, either of the weightless mullion or Browne type. The window sills should be of the sloping (30-deg.) type, and should be approximately 40 inches from the floor. This allows for the installation of benches underneath. It is certain, of course, that windows, when installed, should run clear to the ceiling. Clear glass in all windows and doors is favored. Individual state codes will determine how many windows must be installed per unit of floor area.

Many types of boards have been tried out, but nothing seems to be quite as good, apparently, as a cork bulletin board or a slate blackboard.

The use of mezzanines or balconies in shops has proved quite satisfactory in Oklahoma and Texas, where men like Badger and Rousch have employed them. The plan is to suspend a balcony from a 13-foot or higher ceiling to within 6 feet 6 inches of the floor and to place lockers for general storage under the balcony and provide space on the balcony for the storage of lumber or metal and projects in the process of completion. The plan has been illustrated in the pages of this magazine.

Experience has shown that special flues need to be provided for a ceramic kiln; for forging, heat treating, and melting furnaces; and for automobile exhausts. The flue for the kiln needs to be lined with a fire tile clear to the top and not be smaller than 10 by 12 inches, depending, of course, upon the size of the kiln. Kiln manufacturers usually provide such data.

Central bulletin board at Norwood. Note "Sweep Out," lights, fountain and boys' toilet on right

A blower needs to be placed in the exhaust line for both the metal furnace and automotive exhaust to be sure that the gases escape. Various laws and codes often control the type of installation required.

Questions Regarding Service Features

Service features may, for all present purposes, be defined as the semipermanent mechanical elements of the general plan and construction necessary for maximum utility, convenience, and comfort in a school-shop setting, according to Glenn L. Roberts, a graduate architect with master's degree work in industrial-arts education, who has made the principal study on this phase of the subject. The study of service features includes heating and ventilating, plumbing, fire protection, electricity (exclusive of lighting), and sawdust and fume collection.

The control of radiation should be automatic, placed out of pupils' reach, and should be set cooler than for ordinary classrooms, or between 65 and 68 degrees. If possible, radiators should be placed up on the wall to provide for bench space below. The radiators in the University High School mentioned before, for example, are 9 feet from the floor. Air should be either washed or filtered and changed from six to ten times per hour, depending upon the local state code. While there is plenty of evidence for saying that natural ventilation is still best, it does seem wise to provide for mechanical ventilation if it can be controlled, in order to insure maximum safety and health.

Plumbing is fairly well controlled by code requirements. The pipes, however, should be grouped to reduce expense of installation, located particularly not to interfere with possible equipment installations, and left accessible in case repair or replacement is needed. A drinking fountain may well be included in any laboratory, and the writer follows the rule of providing at least one washing facility to from 12 to 15 pupils, regardless of the type of shop. The following sizes for gas outlets have been followed in various Laboratory of Industries installations: bench outlets, ½ inch; forges and furnaces, 1 inch; kilns, 1½ to 2 inches, depending on the size of kiln. Compressed air is certainly desirable, and drains of various types which have traps including cleanouts are needed. One of these is a ceramic trap; another is a special trap for photographic purposes; whereas a general sink will suffice for use in automotives and finishing units. A damp cabinet ought to have a larger-sized trap because of the chance for clay to find its way into the plumbing.

The underwriters' code, according to Roberts, is quite specific and exacting as regards fire protection. Doors must open out and swing to direct traffic toward the nearest exterior exit. Extinguishers are all right if they are constantly inspected and permanently located. Hose cabinets always need to be inclosed, and waste cans should be purchased of a type which

are both fireproof and easily operated, and should certainly be serviced daily if possible.

Both the control of lighting and power in a laboratory may well be placed in the toolroom or office, depending upon the organization of the laboratory. Either plan has proved most satisfactory in the various installations made. A class dismissal bell is thought to be an essential service feature. It should be centrally installed and controlled from the toolroom. The Norwood laboratory, because of its size, has a signal bell at each end, both of which are wired to the push button placed in the central toolroom. A clock and school telephone are thought to be essential in the effective administration of a mature shop plan.

Christy, of Cincinnati (5), has written an article on the collection of sawdust and fumes. It would seem that considerable study ought to be given to this problem because of the failure of so many systems to work properly.

Questions on Lighting

Bollinger (2) has already made a first report on this phase of the various studies being made in connection with the school-shop-planning investigation. The reader is encouraged to review this splendid article in the March, 1933, number of this magazine. For present purposes suffice it to say that the important things to be understood in lighting are *intensity, diffusion,* and *control.* Whether the source be natural or artificial, the important thing is to secure approximately 15 foot-candles of light at bench height all over a school shop, with intensities of approximately 25 foot-candles in areas like planning, drawing, and printing, where fine work is under way. Coarser work, as in a foundry or forging area, would require only up to 10 foot-candles.

A *foot-candle,* according to Bollinger (2, p. 136), is a unit of measurement of *intensity* of illumination on an object, being equal to the amount of light falling on any given point of a perpendicular surface one foot from a standard candle. Intensity is measured by a relatively simple foot-candle meter, which may be obtained from the General Electric Company for about $25.

Brightness is defined by Bollinger (*ibid.*) as the amount of light emitted or reflected from a surface, measured in terms of *candle power per square inch;* e.g., a 200-watt bulb in a 10-inch glass bowl gives a brightness of approximately 2¼ c.p. per square inch. Authorities seem to agree that there should not be greater brightness than 3 c.p. per square inch. The brightness of the sky rarely exceeds this amount. Light units, such as a lamp on a drop cord, for example, directly in the line of vision should not exceed in brightness ½ c.p. per square inch if eye fatigue is to be avoided. The brightness of light sources may be reduced by inclosing them in translucent globes that tend to distribute the brightness over their entire surface; e.g., a 200-watt clear bulb emits about 180 c.p., but inclosed in a 12-inch white globe, the 180 c.p. is distributed over an area of approximately 110 square inches, or 1.6 c.p. per square inch, a value well within the limits of safety and entirely suitable for shops where the fixture is not continually in the line of vision.

Bollinger goes on to point out that the brightness of reflecting surfaces may be just as distracting and dangerous as direct glare. This form of glare presents itself more frequently because it usually comes from a point on or below the working plane and so falls in the direct line of vision, in which case the light source should be moved to reflect the light away from the worker or the surface treated in order to diffuse and absorb the light rather than to reflect the full brightness of the source.

It is for some such reasons as these that the writer has favored a flat ivory or buff paint for walls. Ivory paint is 71 per cent efficient in reflection, and buff is 64 per cent efficient. It will be interesting to note that olive-green walls are only 21 per cent efficient, and that a dark-gray wall is only 19 per cent efficient. It is assumed that dirty walls would not be much more efficient. The walls above the eye level should be of a light color, such as ivory, light tan, light gray, and so forth. Below the eye level somewhat darker shades of the same color may be used as are placed on the upper walls.

The Venetian *blind* is the type of shade favored by the writer. Perfect control is provided by such a blind, and the installation of this particular type of equipment may be seen in the new Laboratory of Industries at Columbus.

Questions Regarding Noise

Berglund and Fiedler (1) have completed an unusually interesting and valuable research on school-shop noises. Berglund is a graduate electrical engineer and Fiedler is a graduate industrial engineer. Both men have had not only general, but research experience in industry, and have completed their study on noises for masters' degrees in industrial-arts education.

They report that the problem of noise consists of three main parts: *production or prevention, absorption,* and *transmission.* The production of noise refers to the quantity emitted. The absorption of noise refers to the boundaries of the room, such as the walls and ceiling, and constitutes the acoustical problem. The transmission problem deals with the prevention of sound from going beyond the boundaries of the room and involves two points, structural transmission, and air-borne noise.

Noise itself may be described in two ways, according to Berglund and Fiedler (1, Chap. V); first by comparison with some other noise, and second as being either loud or quiet. The least intense noise discernible to the average human ear is designated as the "threshold of hearing," or zero level of decibels. The decibel is defined as about equal to the smallest change which the ear can detect in the power level of a sound. Some noise levels may be of interest to the reader:

Location or Source	*Intensity in Decibels*	*Location or Source*	*Intensity in Decibels*
Inside one's residence	20–40	Street car	83
In business buildings	35–75	Police whistle	83
Street noises	45–80	Steam shovel	86
Church bells	61	Jointers and planers	80–96
General shop situation without machines in operation	68–70	Lion roaring	87
		Elevated train	91
		Steamship whistle	94
Thunder (1 to 3 miles away)	70	Blast of explosives	96
		Subway	97
Circular saw in operation	70–74	Screaming circular saw	100
Pullman coach	75	Riveter	101
Radio loud-speaker	81	Hammering on steel plate	113

These items are quoted above to permit the reader to gain an impression of the nature of noise levels and to note the significance of the statement that the school shop of the future ought not ever be noisier than 80 decibels. The correct sharpening of a saw which screams or whistles will entirely remove this factor. Berglund and Fiedler found that by placing a ½-inch piece of masonite, cork, or felt underneath an anvil block, the noise emitted was reduced by 10 decibels. The same was found in the case of a noisy planer. The tightening of loose belts, pulleys, gears, and guards, and the lubrication of all gears and bearings, as well as the sharpening of saws, cutters, and knives, all tend to reduce the amount of noise emitted.

A ceiling treatment in both the Norwood and Columbus laboratories has been installed to provide an absorption coefficient of approximately .30. This is not quite high enough to achieve the desired results. Something like .50 would be superior. Berglund and Fiedler discuss the calculation of this point in shop plans at length.

Another important item concerns the reduction of noises in transmission. Noises arising from the ventilating system may be reduced by placing the fan and its driving motor upon an insulated cork base. A canvas sleeve interposed between a fan and ventilating duct will reduce the transmission of vibration. Metal hoods used as guards over machinery may be lined with felt, or as an automobile body is frequently lined in order to reduce transmission noises. It is always desirable in the installation of a 5/4 maple floor, for example, on a concrete slab, to

place felt or other suitable material in the hollow areas between the stringers. This method will provide a dead floor, which is entirely desirable both from the point of view of the shop and of the rest of the building.

Conclusion

The reader will have noted that while the bulk of the present article is applied to school-shop planning in general, the approach and illustrations have been more from the industrial-arts viewpoint than from the strictly trade angle. This is seen particularly in such sections as "Principal rooms," "Equipment provisions," and the like, all of which is justified, naturally, because of the predominance of industrial-arts work in the secondary schools of the United States.

It would be interesting to go one step beyond the present study of school-shop planning and prepare a score card for securing objective measures of the excellence of individual plans, provided the results shown by such scores would then be checked against other controls, such as teaching methods employed, the training of the teacher, the amount or lack of equipment used, a functional analysis of results obtained, possibilities for integration with other phases of the school program, fatigue of the teacher and pupils, efficiency of operation in a shop scoring high, and so on. The problem seems to be an endless one, and if the present report proves to be of interest and value to anyone facing the problem of improving his present shop setting or of planning a new one, it will have served its purpose well.

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Principles of Shop-Planning

William L. Hunter

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Ames, Iowa

A valuable check sheet for the use of those intrusted with the planning of the school shop.

THE following principles were formulated, set up, and revised by twenty experienced industrial-arts teachers in conference at Iowa State College during the summer of 1933. The names of the men are as follows:

F. E. Angelbeck, Milwaukee, Wis.
L. M. Benson, Madison, Wis.
Leo Brandt, Newton, Kans.
R. W. Breckenridge, Ames, Iowa
L. W. Buising, Central City, Nebr.
F. M. Everhart, Fontanelle, Ia.
P. G. Frasier, Burlington, Iowa
H. P. Gerber, Aberdeen, S. Dak.
H. E. Gregg, Maplewood, Mo.
S. R. Harding, Aberdeen, S. Dak.
C. Hartline, New Martinsville, W. Va.
J. O. Hodgson, Lincoln, Ill.
O. H. Hubbell, Brookings, S. D.
W. L. Hunter, Ames, Iowa
D. F. Kittle, Cairo, Ohio
G. E. McAfee, Waukegan, Ill.
W. B. Nelson, Alcorn, Miss.
J. M. Norton, Chatsworth, Ill.
H. S. Palmer, Mason City, Iowa
I. S. Smith, Aberdeen, S. Dak.

1. All parts of the shop should be visible to the teacher.
2. Natural lighting should be at least one fourth of the floor area of the shop.
3. When possible, have the teacher's desk in the vicinity of the entrance.
4. Block off or fill up recessed spaces.
5. Arrange equipment to permit free use of aisles.
6. When possible, lockers should be inside the shop and recessed in the walls.
7. The floor should be adapted to the type of shop, avoiding concrete when possible.
8. Provide for maintenance of tools and equipment.
9. Place the key cabinet where it is most convenient.
10. Machines commonly used in sequential order should be placed in the order of their operation.
11. Shop doors should open outward.
12. Avoid placing students where exposure might affect their health.
13. Arrange machinery for maximum safety.
14. Utilize to a maximum naturally lighted areas.
15. The blackboard and bulletin board should face the light.
16. Machines should not be placed on columns or pipes which will transmit sound to other rooms.
17. Avoid an open-beam ceiling.
18. Walls and ceiling should be a light color.
19. Equip with self-contained portable machines whenever practicable.
20. Have transparent partitions between the shop and its auxiliary rooms.
21. All of the shop should be on one floor when one instructor is in charge.
22. Do not permit students to regularly use more than one entrance to the shop.
23. Have one large entrance for each shop.
24. Locate toolroom and tool panels so as to avoid excessive travel.
25. Adequate storage space should be provided.
26. The benches and storage equipment should be large enough to accommodate standard sizes of material.
27. Have fire extinguishers of the correct type and size readily available.
28. Keep obstructions out of line of light.
29. Choose north light when possible.
30. Have soundproof floor, ceiling, and foundations to machines.
31. All machines should be controlled by a master switch under lock and key.

32. Grandmaster-key, master-key, and submaster-key all locks to doors of building.
33. Where necessary, have a dust collector for machines.
34. Windows should extend to the ceiling from a point as low in the wall as practicable.
35. Place equipment so as not to interfere with opening of doors.
36. Provide steel cases and waste containers for inflammable materials.
37. Place the most frequently used equipment near the center of operation.
38. Have an adequate first-aid equipment readily accessible.
39. Have metal-covered glue table.
40. Locate machines so as to accommodate maximum-sized material.
41. Ground all power machines and insulate all metal furniture in an electrical shop.
42. Plan the shop so as to reduce disciplinary problems to a minimum.
43. Distribute items of similar equipment so as to be of value to all workers.
44. Paint safety zones around dangerous machines.
45. Equip dangerous machines with effective guards.
46. Provide exits for fumes, gases, and other injurious substances.
47. Do not have large amounts of lumber, supplies, and materials openly accessible to pupils.
48. Have equipment so located as to avoid all shadows possible on working areas.
49. In determining proper lighting facilities, secure the recommendations of a competent lighting engineer.
50. Avoid using the shop as a passageway to other rooms.
51. Floor of shop should not be more than two feet below ground level.
52. When practicable, have all floor space of the same story on the same level.

SHOP EQUIPPING

Organization and Equipment

J. A. Brandt

Sheet-Metal Instructor,
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A description of the shop organization and equipment for the sheet-metal shop at Mooseheart, Illinois.

THE organization and equipment listed or described in this article has been thoroughly tried out in conducting various types of sheet-metal classes. All equipment has been selected with the aim of providing for the introduction of elementary sheet-metal work that can be developed into trade work without discarding or changing any of the tools, machines, or shop equipment. The same equipment can be used in conducting industrial arts, household mechanics, or trade classes, including the more advanced work of the part-time apprentices or the night-school students.

The Shop

The shop in which sheet-metal classes are to be conducted should be light and well ventilated. Cross ventilation should be provided by properly located windows, if possible.

Artificial lighting should be avoided, as the metal used reflects this light to such an extent that accurate measurement and layouts are difficult to secure.

The fumes arising from soldering operations will cause headaches and sore throats, unless the shop is adequately ventilated.

The shop should be of sufficient size to provide floor space for the assembly of work of considerable size. Because this floor space also will be used for class lectures and demonstrations, the shop should be provided with a large blackboard and a bulletin board.

The Toolroom

A large number of small tools and supplies will have to be checked or supervised by the instructor. To make this possible, a toolroom should be provided. The cost of equipping this room will be saved many times in the reduction of the number of tools lost, and by preventing waste of materials and supplies.

Individual racks or hooks should be provided for each class of general tools, making it possible for the instructor to "check up" at a glance. Figure 8 shows how the toolroom is arranged.

Lockers built under the toolroom counter provide space for the storage of tin plate and large tools not in daily use, while the shelving above the counter furnishes additional storage for supplies. Shelving under this counter should provide space for the storage of 20 by 28-in. plates.

A cabinet of small drawers offers the most satisfactory solution in caring for rivets, nails, ears, pail woods, extra machine parts, and repairs (see Fig. 1).

Benches and Supply Racks

One stake and one machine bench are required. The general dimensions and construction of these benches are shown in

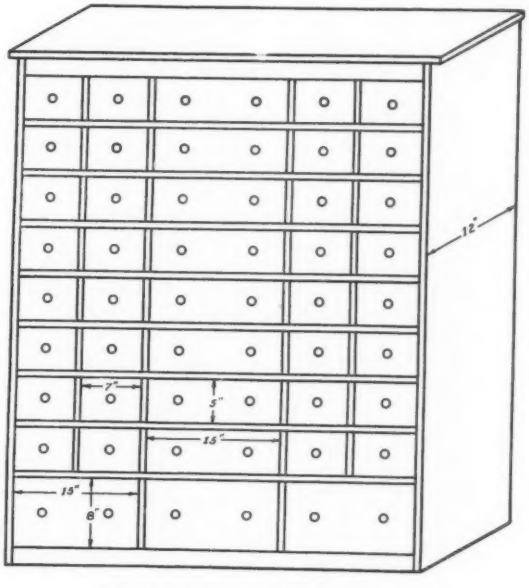

Fig. 1. Toolroom supply cabinet

Figure 2. They are to be constructed of yellow pine or similar lumber available in standard dimensions, though maple tops are desirable. Shelves underneath provide for the storage of wire and scrap material. The tops should project on sides and ends as shown and they should be 1½ in. in thickness. All benches shown should have four legs on each side.

In commercial shops, bench plates are used to hold the various stakes while they are in use. In the school shop it will be found more convenient to have single-casting bench plates made and set into the top of the stake bench providing for the permanent location of all common stakes in general use. This method will save the time of the instructor, prevent broken stakes and injury to the students.

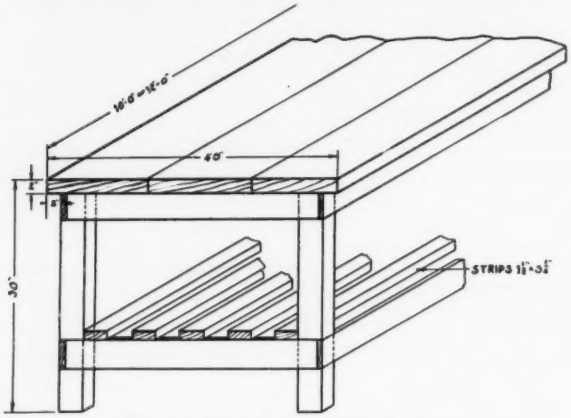

Fig. 2. Machine and stake bench

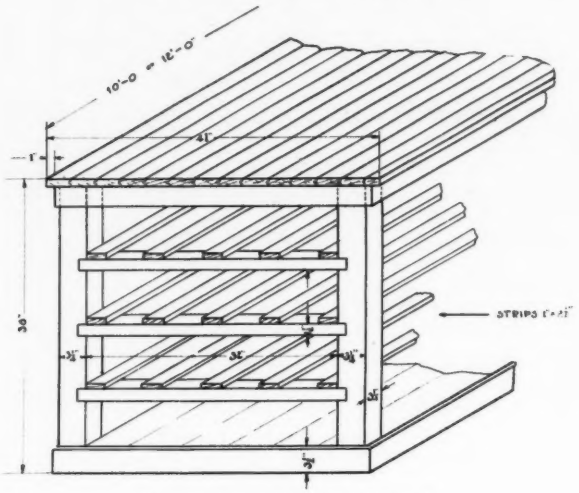

Fig. 3. Layout and stock bench

One layout bench is required. The top of this bench can be used in laying out large projects while the lower part is divided into racks for the storage of several gauges and kinds of sheet metal. Experience has shown that standard-sized sheets, 30 by 96 in., can be more conveniently handled by students than the larger sheets and less waste will result. Consequently all racks and machines are of a size to accommodate sheets of these dimensions.

The construction of the layout and sheet rack is shown in Figure 3. If possible this bench should be constructed of hard wood. The top can be made of tongued-and-grooved maple flooring, attached so that it can be replaced when necessary.

Furnace and Workbench

This bench can be built against the wall on as many sides of the shop as necessary to provide working space for the number of students in the class. General dimensions and construction are shown in Figure 4. The height of this bench can be increased, if the average height of the students will warrant it. Three-inch machinist vises are located on this bench 3 ft. apart on centers, one vise for each student. The furnaces are placed at the rear of the bench in the center of the space between the vises, one furnace for each two students.

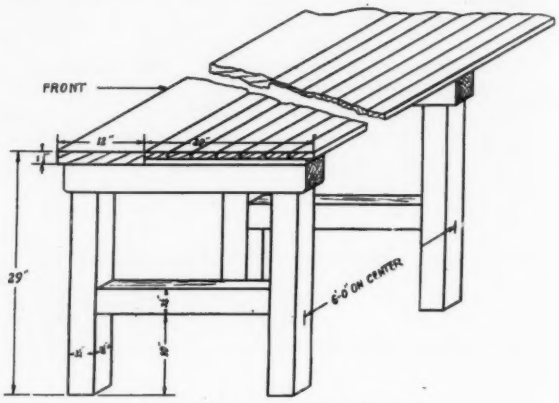

Fig. 4. Furnace and workbench

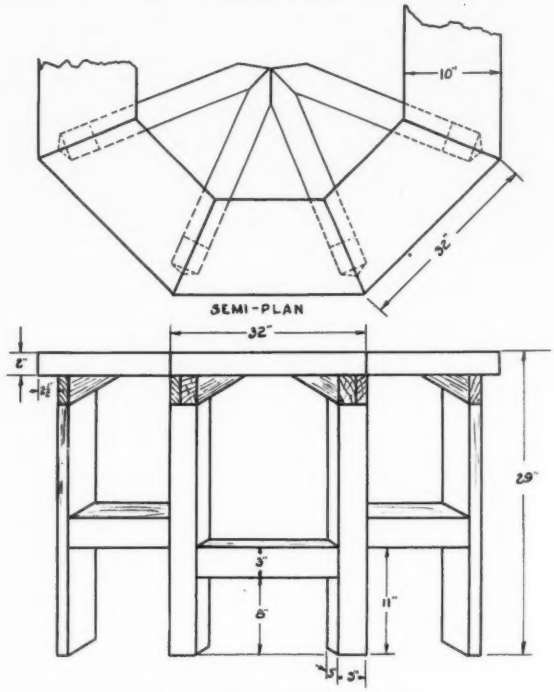

Fig. 5. Octagon machine bench

Small Machine Bench

The most satisfactory method of caring for burring, wiring, crimping, and other small machines that are held in standards is to provide a bench such as is shown in Figure 5, on which each machine may be permanently located. The cost of this equipment will be more than saved in preventing loss due to machine breakage which occurs when students are required to change machines from one standard to another. Metal benches for this purpose may be obtained from several manufacturers. The one shown in Figure 5 is larger, however, and provides more working space between machines. The general dimensions and construction are shown in the illustration. The top should be constructed of maple or other hard wood, and the parts should be bolted together.

Fig. 8. Toolroom. This shows the method that is used in caring for the general tools and supplies

The edge of the top should project at least 2½ in. over the legs or ends of the top rails. A rack built in the center of the bench can be used for holding extra machines and those not in daily use.

Student Lockers

Individual locker space should be provided for each student. A locker 14 by 14 by 18 in. will provide sufficient space. These lockers should be built in units that can be conveniently moved if necessary. The locks should be of a good grade and master-keyed. Metal lockers for this purpose also can be bought.

Keyboards

Keyboards are placed in the toolroom, one board for each class or section with hook or pockets provided for each locker key. The keys should be attached to a piece of band iron ⅛ by 1 by 6 in. long with a small section of safety sash chain. The locker number should be stamped on each key and bar. This method eliminates the continuous replacement of lost keys.

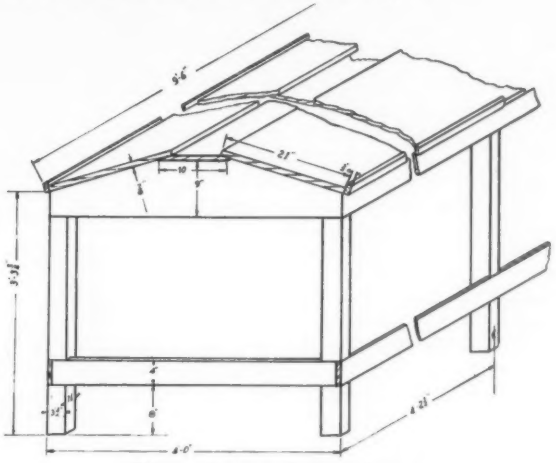

Fig. 6. Pattern drafting bench

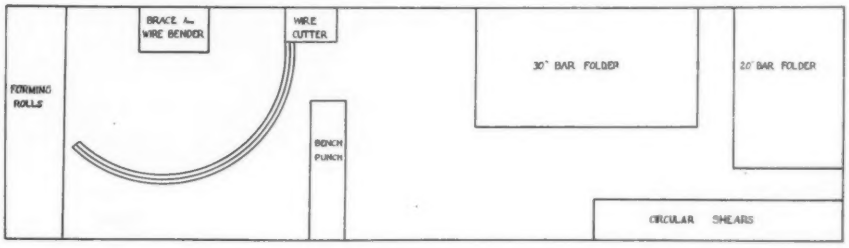

Fig. 7. Plan for machine bench

Pattern-Drafting Benches

If advanced classes in sheet-metal work are to be conducted, it will be found more satisfactory to have all patterns developed in the shop rather than in a separate drafting room. A bench that has proved satisfactory for this work is shown in Figure 6. General dimensions and construction are shown in the illustration. The section of the bench shown provides space for two students on each side. Usually not more than one half of any class will be developing patterns at a time; consequently, the number of benches required can be determined by the number of students in the class.

Machine Bench Plan

In Figure 7 the proposed locations of the machines are shown. If other locations on this bench are to be selected for the machines, all machines should be placed on the bench and tried out to see that sufficient space is provided for all moving parts and that work being done on one machine will not interfere with that done on any other.

School-Shop Tools and Machines

Byron M. Taylor

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While the system described in this article has been written with special reference to the electrical shop, nevertheless it will work equally well when adapted to other industrial-arts shops.

THE system for keeping tools and machines, described herewith, is a suitable companion for the author's system of keeping supplies, described in "Industrial-Arts Supplies" which appeared in the May, 1933, issue of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION.

No list of equipments can be all-inclusive; there must always be regard for the special needs of the community, for the aims of the course, for the financial condition of the school, and for other limiting and modifying factors. Even though this be true, it is possible and feasible to list the basic requirements, and it is helpful and suggestive to include a list of tools, machines, and instruments needed.

While this article is particularly written for the teacher of the electrical shop, there is no reason why the major principles and divisions cannot be applied to other shops as well. The lists included are based on classes of 24 students.

Tools

Some distinguishing mark should be put on each tool to constantly remind all users that it belongs not only to the school, but to a particular shop in the school. Spraying or brushing with a bright-colored lacquer, such as white or yellow, is a very effective way of marking. In fact, lacquer on a tool has a remarkable psychological effect upon the students — they are impressed with the tool's importance and are deterred from any acquisitive impulses. Also, lacquer is not soluble in the greases and acids found in the shop. White lacquer lends the additional advantage of constantly showing dirt and grease, and thus suggesting cleanliness to the user.

Based mainly upon their use and demand, tools have been given four classifications: (1) individual tools, (2) general or common tools, (3) occasional tools, and (4) special tools.

They will be listed and their methods of keeping and checking will be considered in the order named.

Individual tools are those which each student will use each class period and for which he is held individually responsible. The following number is considered necessary for either junior or senior high schools with each class accommodating 24 students. The additional tool is for the instructor.

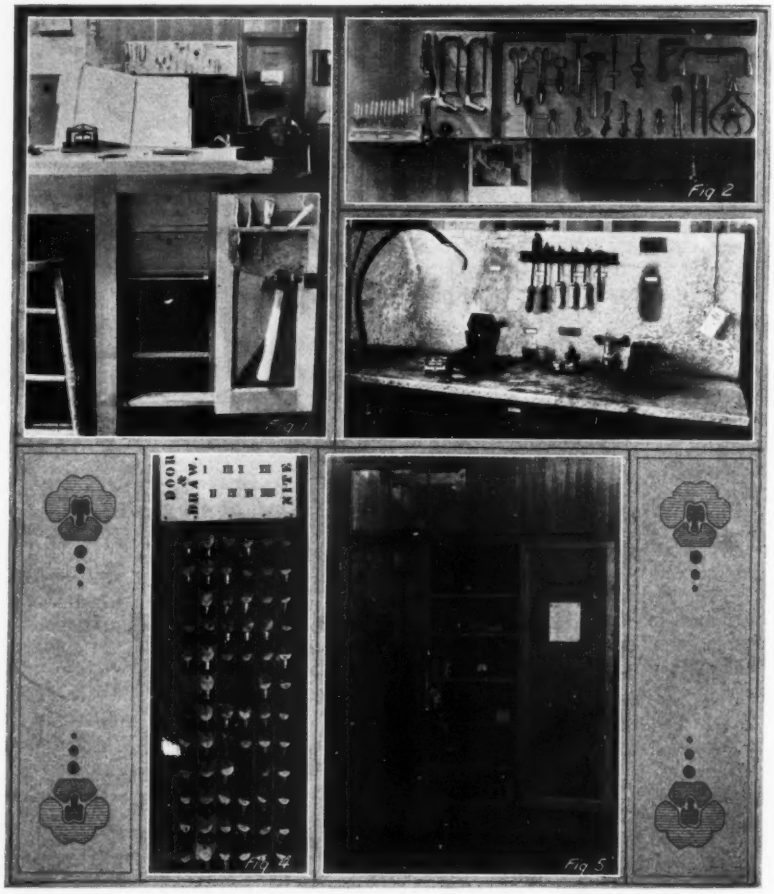


Fig. 1. Individual tool rack and student's lockers
Fig. 2. General tool panel
Fig. 3. Soldering bench
Fig. 4. Panel for student's bench keys.
Fig. 5. The special tool cabinet

Tool	Number	Tool	Number
12-oz. Claw hammer	25	2-in. Pruning knives	25
7-in. Side-cutting pliers	25	12-in. Steel ruler	25
3-in. Electrician's screw drivers	25	3-in. Swivel machinists' vises	25

The vise is clamped to the student's bench and the other tools are kept in the special tool rack on the inside of the door to the individual lockers, as shown in Figure 1.

Besides bearing a coat of white lacquer, each tool is stamped with a number corresponding to the bench to which it belongs.

years' use at two different schools, not one tool was lost or stolen. However, for it to work, the instructor must insist at all times upon its maintenance. No system is foolproof or self-sustaining.

General tools are those which some of the students will use each class period; that is, all of these tools, if they were kept in the toolroom would be checked out and checked in at least once during the period. They are supplementary to the individual tools. The following is a basic list for classes of 24 each:

GENERAL TOOLS

Name and Description	Junior High	Senior High
Auger bits 3/16 in. to 1 in. by 16ths, sets	1	2
Extensions, 18 in.	0	1
Braces, 8-in. swing	2	4
Calipers, spring, outside, 8 in.	0	1
Calipers, spring, outside, 4 in.	1	1
Calipers, spring, inside, 4 in.	1	1
Chisels, cold, assorted sets	1	1
Chisels, wood, assorted sets	0	1
Drills, breast	1	1
Drills, hand	4	4
Portable electric kit (Combination drill, buffer, grinder, etc.)	0	1
First-aid cabinet and supplies	1	1
Hammers, machinists' ball-peen, 8 oz.	2	2
Hammers, machinists' ball-peen, 16 oz.	2	2
Hammers, machinists' ball-peen, 1¼ lb.	1	2
Hammers, machinists' ball-peen, 2 lb.	1	1
Hammers, blacksmith's, hand, 3 lb.	0	1
Pliers, long-nose, side-cutting	2	4
Pliers, long needle nose	0	2
Pliers, extra long, flat-nose	0	2
Pliers, radio	0	2
Pliers, diagonal cutting	2	4
Pliers, combination gripping	2	2
Pliers, end-cutting nippers, 8 in.	1	2
Pliers, end-cutting nippers, 5 in.	1	2
Punches, assorted sets	1	1
Reamers, pipe-burning, ¼ in. to 1 in.	0	1
Rules, straight steel 72 in.	0	1
Saws, hack, adjustable frames	4	4
Saws, compass	0	1
Saws, coping	2	2
Saws, hand, crosscut	1	1
Saws, hand, rip	1	1
Scissors, flat pattern, 8 in.	1	2
Screw drivers, insulated handle, 8 in.	2	4
Shears, heavy bench shears	1	1
Squares, 2 ft. by 1 ft., steel	0	1
Squares, try, 12-in. blade	0	1
Squares, try, 6-in. blade	2	2
Snips, tinner's, 12½ in.	1	1
Snips, tinner's, curved blade, 12½ in.	1	1
Snips, tinner's, 8 in.	2	2
Snips, tinner's, sharp-pointed, 12 in.	2	2
Soldering coppers, assorted	6	6
Soldering coppers, electric	1	1
Soldering coppers, handles	12	12
Solder dippers	1	2
Solder pots	1	1
Wire gauges, B & S.	1	1
Wrenches, monkey, 12 in.	1	1
Wrenches, monkey, 8 in.	1	1
Wrenches, pipe, 14 in.	0	2
Wrenches, pipe, 10 in.	1	2
Wrenches, pipe, 6 in.	1	2
Wrenches, crescent, 10 in.	0	2
Wrenches, crescent, 8 in.	2	2
Wrenches, crescent, 6 in.	2	2

For example, all tools at bench No. 4 are plainly marked so. This prevents one student from "borrowing" from another to replace a lost or damaged tool from his own bench. More important, still, it helps to develop a sense of individual responsibility within the student himself.

The student is strongly impressed with the fact that he is responsible for his bench and for all tools, books, etc., appertaining thereto, while he is in the shop. He checks his bench the first thing upon entering the class and the last thing upon leaving. If, upon entering, he finds anything missing he reports it immediately to the instructor who at once has the student from the preceding class brought back to the shop. If, confronting each other, either fails to produce the lost tool, then they are both taken to the vice-principal, who may exact payment from parents for any lost or damaged school property.

In the several years in which the author has used this method, he has never had to take any tool problem out of the shop. He has found that if at the beginning of the term the entire shop system is explained to the boys and their attention is called to the fact that toolkeeping is a coöperative enterprise, they soon get the right spirit and become helpful and take pride in maintaining a correct system.

If there are, for example, five full classes of electricity in each teaching day, then five students will use each set of individual tools. While each student is individually responsible for the tools during his class period, he is concerned also with the actions of four other students and thus the whole scheme becomes a "community" enterprise. Each student is thus spurred to careful checking by the knowledge that he too is being checked.

That this system "works" is attested by the fact that in four

The tools just enumerated, are kept on tool panels fastened to the wall, in various parts of the shop, nearest the work where the student will have most use for them. The hacksaws, for example, are not all fastened to one panel but are divided among several panels. The panels are painted white with an outline of each tool in red "shadowed" thereon (see Fig. 2). Each tool has a fastener whereby it is held securely in place yet may be quickly removed or replaced. To stimulate the student to use correct terms when speaking or writing of the tools, a sticker with the catalog name thereon is placed beside or beneath each tool.

The open tool panel is considered best, provided the entire shop can be locked with the instructor possessing the only keys. If others have keys, it is advisable to equip each panel with a vertical sliding cover which may be locked.

The student is free to take any tool from the panels and use it wherever he needs it during his class period. He returns it to its proper place when he is finished with it. At the sound of the warning or "clean-up" bell, all tools must be returned to the panels. A missing tool can be easily spotted by its contrasting "shadow." The entire class is held until all "shadows" are filled. This system may be termed a limited "honor" system in that the student is free to use any tool he chooses but the entire class is responsible for the return of all general tools. In case a general tool is lost or stolen its price is divided among the members of the class in which the offense occurred and the *pro rata* cost is added to each Student's Requisition (see May, 1933, issue of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION). Needless to say, when the students once understand that this will happen, it is seldom necessary to use the procedure.

Included with the general tools system is the *soldering bench*

and its accessories. Figure 3 shows that above the panel on the sheet-metal wall cover are placed the soldering coppers. The instructor's instruction is supplemented by a pamphlet on *How to Solder*.

Also the keys and key boards are included among the general tools because they, too, are kept and checked by a similar system. On either side of the main shop entrance, or on each wiring-panel rack, are kept the students' bench keys (see Fig. 4). On one board are keys for benches Nos. 1 to 12 inclusive, on the other for benches Nos. 13 to 24 inclusive. Reading down on extreme left-hand column are the bench numbers; reading across left to right are the main door and drawer keys on one tag and the individual locker keys on their separate tags. As an aid to the student in differentiating the keys and as an aid in checking them, each vertical column on the board is painted a different color. For example, all individual locker keys for I and II (first shop period) are in the yellow column and their key tags are also yellow; all for V and VI (third shop period) are in the green column, etc. Thus student with Bench No. 4, third shop period, would upon entering the shop take No. 4 door and drawer key and No. 4 key with the *green tag;* student No. 10 would take door and drawer key with the same number and No. 10 key with the green tag, etc. As a further aid to the student, the front of his individual locker is painted the same color as his individual key tag; that is, reading down on the front of the individual lockers (see Fig. 1), the colors run in same order as reading from left to right on key boards.

It is seen that all students in any one class have the same color individual key tags and lockers — the first shop period then becomes the "yellow" class, third shop period the "green" class, etc. The shop superintendent's work is thus facilitated in checking the keys as he stands at the door by simply seeing that all keys of his color plus the door and drawer keys are in place.

As with all general tools the students are not dismissed until all keys are in their proper place.

Advantages claimed for this system of keeping general tools, keys, etc., are:

1. It is efficient in that there is no time lost in checking the tools out of a toolroom or from a tool case. The latter two methods always cause congestion of pupils about one place with the attendant noise, scuffling, and danger.
2. It is economical because fewer tools are needed as a result of more proficiency in handling and checking them. Also each tool under a toolroom system will be kept out the entire period, while with this system, a tool is returned as soon as the student is finished with it.
3. Tools are conveniently placed for the student in different parts of the shop.
4. Checking is easy, simple, and sure.
5. Students are checked only in returning tools and are not bothered with "red tape" in getting them.
6. Students "like" this system but are opposed to toolroom system.
7. It reduces tremendously the work usually done by the boys in the stockroom, thus leaving them time to handle supplies and the occasional tools.
8. It constantly and rather forcibly reminds the students of their interdependency with a consequent development of their coöperative sense.

Occasional tools are those which, as the name implies, are irregularly used. Though necessary to shop equipment, their use does not warrant taking up wall space in the shop for them. Their shape or bulk may also forbid them being placed on the wall. The following may be considered a basic list:

Name and Description	*Junior High*	*Senior High*
Blowtorch, 1-qt. size	1	1
Hickeys, ½ and ¾, each	0	1
Magnets, bar and horseshoe, each	6	6
Steel tape, 50-ft.	0	1
Stocks and dies Pipe, ⅛ in. to 1 in., by eighths	1	1
Taps and dies, sets U.S.S. ¼ in. to 1 in., by sixteenths	1	1
Taps and dies, sets Machine-screw sizes, 2–56 to 12–24 inc.	1	1
Tungar rectifier, portable	1	1

The occasional tools are kept on the shelves of the stock or supply room and may be had by the student signing up for them. Since they are so few in number and so infrequently used, they impart no hardship upon the supply-room clerks and cause no congestion or great loss of time in handling.

Special tools are those which, because of their expense or their delicacy, or because of the skill required to use them, require a separate classification and a separate division in the shop. They should be handled directly by the instructor or by a responsible student charged with that specific duty. Obviously, with the foregoing definition as a criterion, all *meters and testing instruments* will come under the head of *special tools*. They are herein so considered:

SPECIAL TOOLS

Name and Description	*Junior High*	*Senior High*
A.C. motor demonstration set (different phase generation and rotors)	0	1
Battery demonstration set (different cells can be assembled)	1	1
Bensen photometer	1	1
Calorimeter	1	1
Centigrade thermometer	1	1
Condenser, variable, 43-plate	1	1
Electric marking pencil	1	1
Meters		
Ammeter, a.c., 0–60	1	1
Ammeter, a.c., with special current transformer, 0–20 by 10ths	0	1
Ammeter, d.c., with shunt, 0–150	0	1
Ammeter, d.c., 0–20	1	1
Ammeter-voltmeter, combination 2-scale — 0–30 volts 1-scale — 0–90 millevolts 3-scale — 0–30 amps	1	1
Galvanometer, zero center	1	1
Milliameter, a.c., 0–500	0	1
Milliameter, d.c., 0–500	0	1
Voltmeter, a.c., 0–150	1	1
Voltmeter, a.c., 3-scale, 0–750	0	1
Voltmeter, d.c., 0–150	0	1
Voltmeter, d.c., 0–20	1	2
Voltmeter, d.c., 3-scale, 0–750	0	1
Wattmeter, 110–220 Volt, 30 amp., d.c., or a.c.	0	1
Watthour meter, 125 volts, 10 amps., single-phase, residence type	1	1
Wheatstone bridge	0	1
Resistance box, 500-ohm	1	1
Resistance box, 1000-ohm	1	1
St. Louis dynamo	1	1
Speed indicator	0	1
Steam heater	1	1
Transformer, 50-watt, 110/11,000 volts	0	1
Transformer, 200-watt, 110/32/24/12/6	1	1
Telegraph sets, including relays, sounders, and keys	2	2
Telephones, complete bridging	0	2

As an item of economy, the writer suggests that as much of the apparatus as possible be borrowed from the physics or science departments in the school.

All special tools should be kept in a special cabinet (see Fig. 5) near the instructor's desk. Since the instructor will

probably use them most in his demonstrations, they should be handily and systematically arranged in the cabinet. Identifying and descriptive marks or stickers should be placed on each tool.

Each student signs up for each special tool taken out. On the back of the cabinet door is a convenient place to put the record sheet. The front of the door may be used as a bulletin board. Either the instructor himself acts as clerk or he may assign the duty to a responsible student. With a well-supervised system there is very little excuse for damaged or stolen tools or instruments.

Perhaps one wonders why several "systems" of toolkeeping and checking are recommended. It is the writer's contention that the largest contributing factor in choosing a given system depends upon the kind of tools used, and how and by whom they are to be used. Surely one system could not give the readiness and personal responsibility of the individual tools, plus the efficiency and coöperativeness of the general tools, plus the care and supervisorial training of the special tools. Each class of tool demands it own system adapted to its own particular use and care.

Machines

Under the caption "machines" are listed those large pieces of equipment which, though not necessarily fixed, and occupying floor space, are used in the preparation of stock, or for construction and repair of projects, or for the demonstration of and experimentation with apparatus.

A basic list follows:

EQUIPMENT AND MACHINES

Name and Description	Junior High	Senior High
Anvil, blacksmith's, 100-lb...	0	1
Armature tester or "growler"	1	1
Battery, 6-volt, lead-sulphuric acid	1	2
Battery, cell tester and hydrometer	1	1
Breaks, sheet-metal	0	1
Burners, gas (Chapter III & Plate)	2	2
Circuit breakers, air, single-pole, overload 25 amps. 125-volt	1	2
Controllers, for multispeed motor	0	1
Generators, a.c. to d.c. — d.c. to a.c. Motor — generator set, 5-h.p., a.c. 1-2-3-6 phase, 125-volt, d.c. series, shunt compound, 125-volt.	0	1
Generator, a.c. to d.c., m.g., set, 2-h.p.	1	1
Generator, auto, of different makes	1	2
Grinder, bench, electric on pedestal	1	1
Lathe, bench engine, 9-in. swing, with accessories	0	1
Magnet, testing, 10,000-ohm.	1	1
Motors		
Auto starter or compensator	0	1
Compound, 1-h.p., 110-volt, d.c.	0	1
Multispeed, 1-h.p., 3-phase, 220-volt	0	1
Series, 1-h.p., 110-volt, d.c.	0	1
Shunt, 1-h.p., 110-volt, d.c.	0	1
Split-phase induction motor, fractional h.p., 110-volt, 60-cycle	0	1
3-Phase induction motor, squirrel-cage, 220-volt, 60-cycle, 5 h.p.	0	1
Universal, fractional h.p., 110-volt	0	2
Press, drill electric	1	1
Press, punch for stamping laminations	0	1
Rheostats, compression, 275-watt	0	1
Rheostats, field for shunt and compound motors	0	4
Spring balances, 0–30 lb.	1	1
Starting Boxes		
For compound motors	0	1
For shunt-wound, 1-h.p., 110-volt, with overload and no voltage rebase	0	1
Switchboard, as required	1	1
Transformers, single-phase, 220/110/55/22/11/6 volts, 3 kwa.	1	1
Vises, machinists', 4 in.	2	2
Vises, machinists', 6 in.	1	1
Vises, pipe on pedestal	1	2
Welder, electric spot	0	1
Woodworking set, combination lathe, saw, jointer, etc.	1	1

Those machines not in continuous and permanent use in the shop may be kept in the stockroom and may be withdrawn in the regular manner by students or by the instructor.

Oiling, repairing, and reconditioning of machines requires competent work, and if a student is allowed to do any of it, he must be carefully supervised by the instructor. The instructor may assign many of these duties to the more capable students who gain valuable experience therefrom.

The system, just described, is not foolproof nor self-sustaining but by close supervision it is very successful. After all, the "acid test" is whether the tools are kept and accurately checked — there must be few or none lost, damaged, or stolen tools. All machines must be carefully and efficiently used and conditioned. In that light, this system has been successful.

The Heat-Treating Laboratory

W. P. Childs

Pasadena, California

A description of a heat-treating laboratory which might be found useful in junior colleges or in technical high schools.

THE laboratory for heat treating and metallurgical work at the Pasadena Junior College was put into service February, 1932. Figure 1 shows a general view of the department, looking from east to west. The picture was taken before the necessary hoods and draft pipes had been installed. The room is 20 by 80 ft. The natural lighting is taken care of by clear glass in steel sash, and the natural ventilation is provided for with pivoted steel sash in the large windows. Five-hundred-watt frosted-bowl lamps set in white-enamel, 16-in. diameter Benjamin reflectors, placed on 20-ft. centers, take care of the artificial lighting.

Beginning at the right in Figure 1, the first furnace is a 5-kw. electric air-drawing oven. The open space next to this is for a future electric-furnace installation. The third space is occupied by an 18-kw. box-type electric furnace. The fourth position is occupied by an oil-fired general-purpose heat-treating furnace, and the fifth, by a high-speed gas-fired furnace. The large furnace in the center is a heat-treating and carburizing gas-fired furnace. Just behind the large furnace (but not showing in Fig. 1) are two pot-type gas-fired furnaces, one of which is used for cyanide and the other for lead hardening. The next furnace shown is a gas-fired forging furnace, for use with a 150-lb. tool dressing hammer. Beyond the hammer and only partially showing, is a gas-fired forge, and finally there are two open spaces for gas-fired furnaces for future installation.

Figure 2 is a view looking from west to east and shows the lead-pot furnaces with the carburizing furnace.

Figure 3 is a front view showing several of the furnaces and

the spacing between. Large quenching tanks will be installed in the foreground in the very near future.

Figure 4 shows the control panel. This panel is equipped with both manual and automatic control for the various furnaces. The pyrometer on the right is the latest type of flush mounting recording potentiometer and is one of the first to be installed on the coast. This instrument can be connected, by means of the proper switches on the control panel, to automatically hold any one of four furnaces to any desired temperature within the heat range of the furnace. Also, this instrument can be connected to any one of seven furnaces so as to draw a time-temperature curve showing the temperature in any of the furnaces at a given time. The central instrument on the control panel is an indicating pyrometer which will indicate the temperature in any one of seven furnaces. The electrical contacts between the various furnaces and the indicating pyrometer is made by pushing the properly numbered push button (shown in a row of twelve just below the central instrument) corresponding to the furnace number. The instrument on the extreme left is a controller-type of pyrometer, which will record and control the temperature of any one furnace or it will draw a time-temperature curve for any one of seven furnaces when they are controlled manually.

The instrument shown at the right in Figure 4 is put in operation by an inclosed switch (shown inside the case in the upper left-hand corner) and is then connected to the desired furnace by turning a pair of control knobs (shown in a row of eight near the middle of the panel) so that the pointers on the shafts of the knobs point to the right. The right-hand knob of the pair connects the thermocouple and the left-hand knob,

Fig. 1. The heat-treating and metallurgical laboratory. The necessary hoods and draft piping were installed after this picture was taken

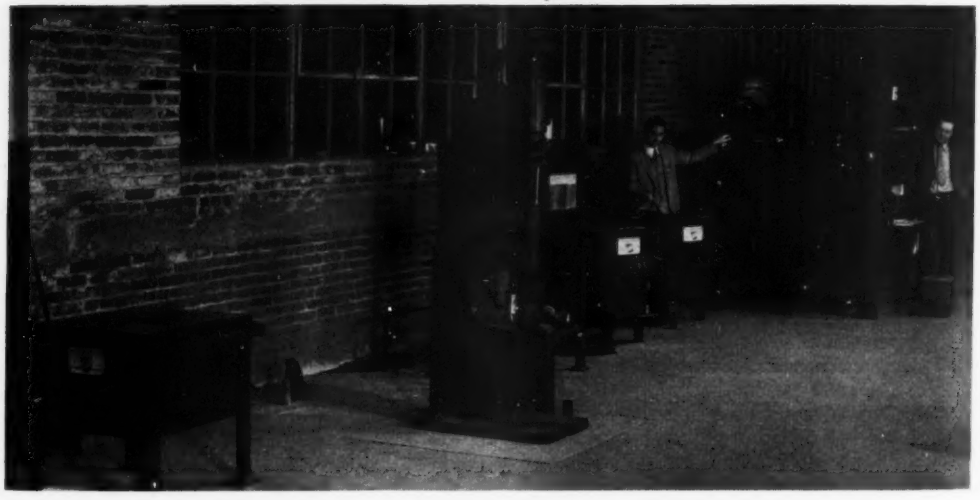


Fig. 2. The 150-lb. tool dressing hammer, the lead pot furnaces, and the carburizing furnace

Fig. 3. The front view, showing the general arrangement of the furnaces

the automatic control mechanism of the particular furnace with the instrument by means of a double-throw switch (shown in a row of four just below the control knobs). Referring to the row of four double-throw switches, when the handle of the switch points to the right, the furnaces are connected so as to be automatically controlled and when the handle points to the left, the furnaces are connected for manual control. The same thermocouple and the same thermocouple control knob are used to connect the furnace with the instrument, to give time-temperature readings, whether the furnace is manually or automatically controlled. The three knobs at the bottom of the panel are thermocouple switches only, and are connected by proper switches to any one of the three temperature-recording instruments.

Beginning at the left-hand pair of knobs shown in the middle of the panel: the first pair are connected with the box-type electric furnace; the second pair to the high-speed furnace; the third pair to the large carburizing furnace; and the fourth pair are for control of the electric furnace to be installed in the future. Referring to the three thermocouple knobs at the bottom of the panel, the one on the left connects the oil-fired furnace with any of the instruments shown at the top of the panel. The center knob connects the gas-fired lead-pot furnace, and the right-hand knob connects the cyanide-pot furnace to any one of the three instruments at the top of the panel.

Returning to Figure 1, the electric air-drawing oven is equipped with open-type heating units, a chromel-alumel thermocouple, an indicating pyrometer reading to 800 deg. F., and an automatic-control switch. The furnace uses 220-volt current. This furnace will be used for instruction and experimental work in tempering tools and other small parts.

The box-type electric furnace is equipped for both manual and automatic control. The heating elements in this furnace are not exposed except in the roof. The current for use in the heating elements is transformed (by a transformer located on the bottom of the furnace) from 220 volts to 75 volts. A fuse protects the furnace against overheating.

The oil-fired furnace is not automatically controlled, but the temperatures in it can be indicated on the indicating pyrometer or a time-temperature curve may be drawn by either of the other two recording instruments.

The forging furnace and the gas-fired forge are not connected to the control panel. The gas and air for these machines are controlled by hand by means of a globe valve on the gas line and a rheostat governing the speed of the blower motor.

The gas-fired forge, the forging furnace, the cyanide pot,

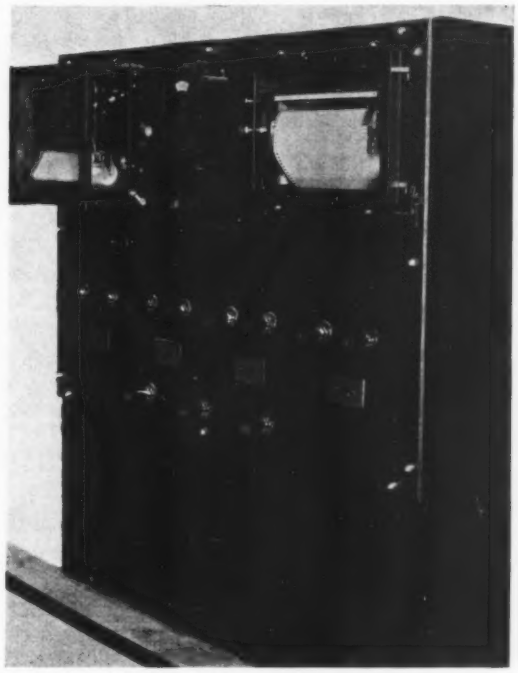


Fig. 4. The furnace-control panel

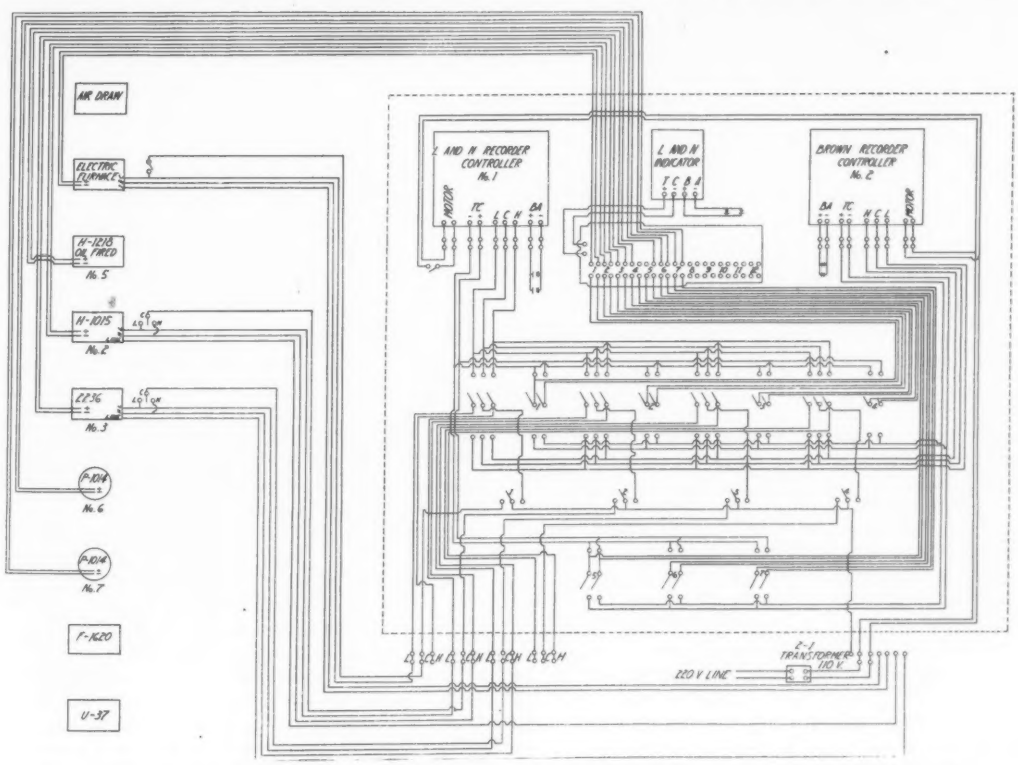


Fig. 5. The electrical diagram showing the connections between the furnaces and the control panel

the lead pot, and the high-speed furnace are each equipped with a ⅛-h.p., 220-volt, electric motor-driven blower for furnishing the air to the furnaces. The blower for the carburizing furnace is direct driven by a 220-volt, 1-h.p., slip-ring, inclosed motor. The blower and motor are mounted on the top of the furnace at the rear right-hand corner. The blower for the oil-fired furnace is also direct driven by a slip-ring inclosed-type 1-h.p., 220-volt motor. The blower and motor are located centrally below the furnace.

Figure 5 is the electrical wiring diagram showing how the various furnaces are electrically connected with the control panel.

SHOP MANAGEMENT

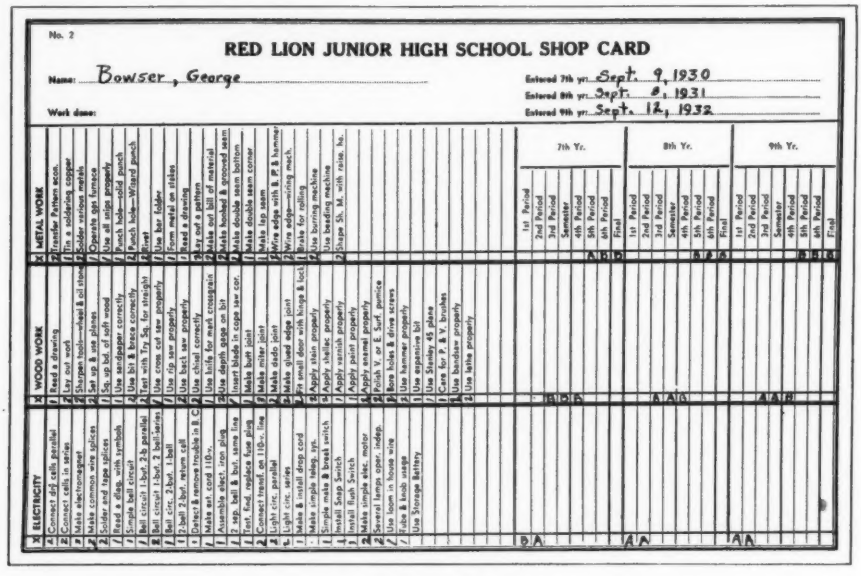
The Shop Card

G. B. Westerberg

Red Lion Junior High School,
Red Lion, Pennsylvania

A progress card which helps the teacher to keep a close check on the type and extent of the work done by the student in the general shop.

AMONG devices for checking and recording progress in the school shop, I have found the shop card which I will describe here to be of real value. My tentative shop analysis and the A.V.A. tentative analysis[1] formed the basis for the idea. It has been a valuable device in helping me check and keep record of pupil progress since 1930.



No. 2

RED LION JUNIOR HIGH SCHOOL SHOP CARD

Name: Bowser, George — Entered 7th yr.: Sept. 9, 1930 — Entered 8th yr.: Sept. 8, 1931 — Entered 9th yr.: Sept. 12, 1932

Work done:

		7th Yr.						8th Yr.						9th Yr.					
		1st Period	2nd Period	3rd Period	Semester	4th Period	5th Period	6th Period	Final	1st Period	2nd Period	3rd Period	Semester	4th Period	5th Period	6th Period	Final	1st Period	2nd Period	3rd Period	Semester	4th Period	5th Period	6th Period	Final
3	METAL WORK					A	B	D						B	P	B						B	B	B	
5	WOOD WORK				B	D	D						A	A	G						A	A	P		
7	ELECTRICITY						D	A						A	A							A	A		

Shop Progress Card

Since this card was first put into use, more complete analyses have been made of the shop subjects taught. The operations or units of instruction are listed on progress charts[2] just as they are listed on the analysis chart. While the operations listed on the card are not as well defined as those listed on the analysis chart, they are broader but can readily be used in conjunction with a well-defined analysis.

To make the card valuable as a recording device, we must first admit the value of the operation as the basis of instruction. This does not mean that we are to teach a series of exercises which involve the operations in the order of their appearance on the analysis chart. The operations are to be taught as the need for them arises in a particular job.

A system of this sort may appear to be time-consuming. It does, of course, take a little more time, but there is the satisfaction of knowing that the check kept is well defined and permanent. If any question arises, the amount of work any pupil has completed may be checked up on the chart and card. If school marks are of any value, and many educators believe that they are, then it is desirable to keep the records of pupils as closely and accurately as is possible. As the illustration shows, the card is intended for use during the entire junior-high-school period. This is a distinct advantage as each pupil's progress can be thus more closely checked.

The card is so arranged that if woodwork is taught one year, metal work another year, and electricity still another year, the marks may be recorded under each group by the year. Or if the general-shop plan is used as we use it at Red Lion, the marks may just as easily be recorded under each year's work.

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[1] Report of Committee, American Vocational Association: Standards of Attainment in Industrial Arts Teaching, 1929.

[2] R. W. Selvidge and V. C. Fryklund, *Principles of Trade and Industrial Teaching*, Manual Arts Press, Peoria, Ill., 1930, pp. 111–112.

This shop card is not intended to be a cure-all for general-shop teaching, nor is it intended to be a timesaver for the teacher though he may need timesavers. However, it is an efficient method for keeping an accurate check on each pupil's progress during his entire junior-high-school shop experience.

In schools where the administration does not yet realize that the industrial-arts teacher has a specific program to fulfill and therefore expect him to do all the odd jobs that come to their attention, this progress chart may help to awaken a consciousness that the shop teacher's job may be at least as important as that of the mathematics, Latin, or history teacher's.

A Useful Grading System

Edward L. Condon

Art Director, Public Schools,
Central Falls, Rhode Island

This article describes a simple method by which the average of grades expressed in per cents or by letters, may be ascertained quickly.

TEACHERS of mechanical drawing and other subjects of a vocational nature are frequently handicapped because they lack a suitable method of determining correct averages denoting achievement of students when marking report cards.

In denoting marks of achievement or grade, many schools use the letter system, such as A, B, C and f. In addition to this, plus and minus marks are often used. When the cumulative method of marking is used, it is necessary that all symbol letters be transposed to marks of corresponding per cent, as it is impossible to add one letter to another.

When adding the marks in terms of per cent, the amount accumulated is often very large. This tends to increase the chance for error when attempting to figure the average for each report period. Not that alone, but it places an unnecessary burden upon the teacher and is the cause of much wasted time.

The following system has been used successfully by the author in classes of art and mechanical drawing. The same system, with slight modifications, may be used in other types of work.

A report card, shown in Figure 1, is kept for each student by the instructor. The card is a regular index card 4 by 6 in., and may be mimeographed or printed. The name of the student, his desk and period numbers are written on the card and

Name _____ Desk _____ Period _____

Unit marks are in credits and are cumulative													Date
Letters	f	C-	C	C+	B-	B	B+	A-	A	A+			
Credit	0	1	2	3	4	5	6	7	8	9			
Per Cent	59-60 – 65-70			75-80		85-90		95-100					
Drawing	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Credit														
Drawing	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Credit														
Drawing	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Credit														
Drawing	43	44	45	46	47	48	49	50	51	52	53	54	55	56
Credit														

Freshman	Home room no.		Reports	1	2	3	4
Sophomore	Remarks:-		Grade				
Junior			Conduct				
Senior			Effort				

I.A.V.E.

Fig. 1. The report card. Original size 4 x 6 in.

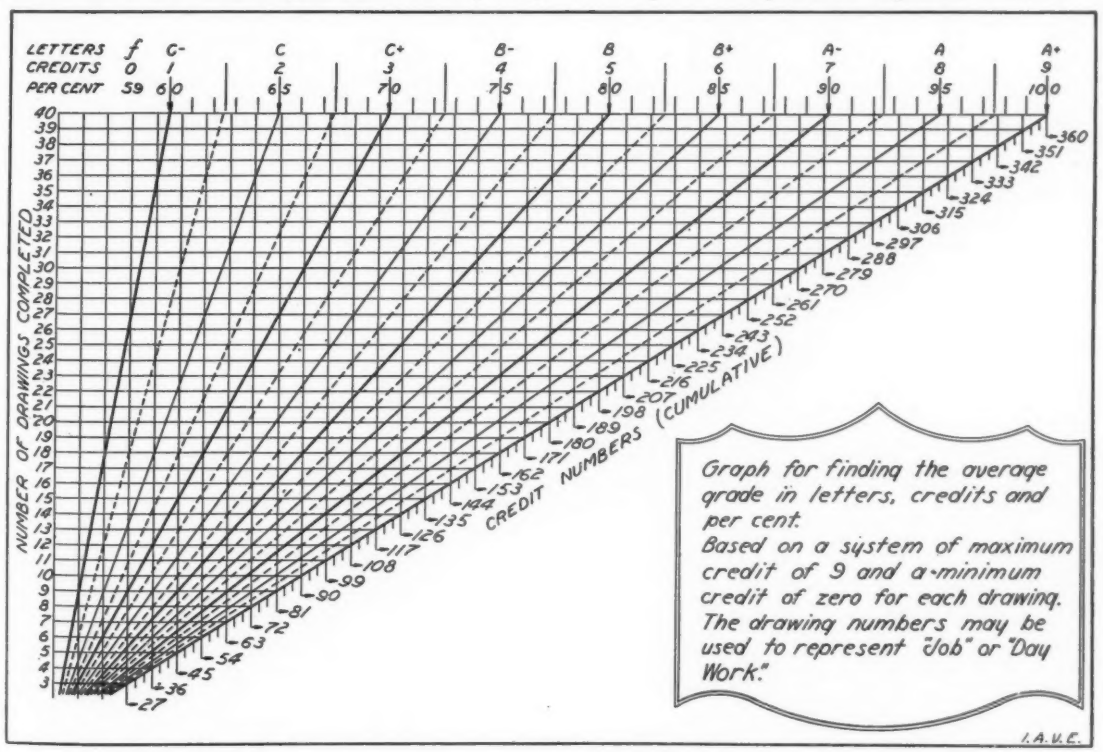

LETTERS f C- C C+ B- B B+ A- A A+
CREDITS 0 1 2 3 4 5 6 7 8 9
PER CENT 59 60 65 70 75 80 85 90 95 100
NUMBER OF DRAWINGS COMPLETED
CREDIT NUMBERS (CUMULATIVE)
Graph for finding the average grade in letters, credits and per cent.
Based on a system of maximum credit of 9 and a minimum credit of zero for each drawing.
The drawing numbers may be used to represent "Job" or "Day Work."
I.A.V.E.

Fig. 2. Grade Finding Graph

a check mark used to denote his class. A space is provided for his homeroom number. A series of spaces in the lower right-hand corner are for the report marks when they fall due.

The procedure of marking is as follows: When the student completes his first drawing the instructor places the credit mark in the space for drawing 1. This credit mark may be either 0, 1, 2, 3, 4, 5, 6, 7, 8, or 9. The equivalent for these credit numbers in letter symbols or per cent may be found at the top of the card. The credit for the second drawing is mentally added to that of the first and the total is placed in the space for drawing number 2. This method continues until the period for the first report closes. The average credit may be found by dividing the last credit by the corresponding drawing number. The symbol letter equivalent to this average credit number may be found at the top of the card and should be marked in the space opposite the word "Grade" for report 1.

For example: If, at the end of the first report period, the student has completed 18 drawings and accumulated credits amount to 108, then, by dividing 108 by 18, the average credit is found to be 6. And according to the table at the top of the report card, its corresponding per cent is 85, and its equivalent letter symbol is B+.

At the beginning of the next report period and at the completion of the next drawing, its credit is added to that of the preceding one and the result placed in the next space. This procedure continues throughout each successive report period until the end of the year. A student's average may be found at any time between report periods if desired, by the same method.

It is apparent that as the student approaches the last two report periods, his credit and drawing numbers will have increased to such an extent that to determine his average would mean a matter of long division. To avoid the necessity of the teacher figuring with pencil and paper, the graph shown in Figure 2 was designed. While this graph is somewhat limited in scope, it may, however, be increased in size to take in any number of drawings and credit numbers, depending only on the size of the sheet on which it is drawn.

To use the chart, the horizontal line opposite the drawing number selected is followed until it is intersected by the vertical line corresponding to the cumulative credit. From this point of intercession, follow in a right oblique upward movement, the diagonal lines between which this intersection occurs until the top of the graph is reached and the required result will be found in average credit, per cent or letter.

Whenever a student has failed to complete the required minimum number of drawings for any given period, his average should be figured by dividing the accumulated credits by the required minimum number of drawings instead of by the actual number of drawings submitted.

Example: It is required that 18 drawings be submitted for the first report period. A student submits 16 drawings and has accumulated 96 credits. If 96 be divided by 16 the result would be 6 credits, or 85 per cent, or B+. But, as 18 is the minimum required, the average is found by dividing 96 by 18 instead of 16. This produces an average of 5 1/3 credits, or approximately 81 per cent, or B.

While in this case, the variation is very slight, it illustrates the importance of using the correct drawing number in order to obtain accurate results.

Vocational instructors, in charge of classes in woodworking, auto mechanics, electric wiring, sheet-metal construction, and so forth, may find it advantageous to use this system of marking. By substituting the word *job* for the word *drawing* in many cases would be sufficient. In other cases, however, where the jobs performed during the day are so numerous, the word *day* may be substituted for the word *drawing*.

A Shop Record System

Alfred H. Hausrath, Jr.

Vocational Education Department,
Iowa State College, Ames, Iowa

The problem of accounting for material used by the student in the school shop is always troublesome. The system described herewith has worked well in the author's classes and may be found helpful elsewhere.

DOES your school furnish all materials free to pupils? Do all your boys make the same projects? Do you have small classes? Do your records give you all the information you need? Do you like to collect money from the boys?

If you answer these questions affirmatively, read no further.

With current tendencies emphasizing individual instruction, greater variety of shop experiences, and with increased enrollment necessitating larger classes, the keeping of adequate shop records has become a serious problem.

As a solution, the writer devised the card index system described herewith.

Figure 1 is a 4 by 6-in. card, designed to meet the needs of the industrial-arts woodshop, the general shop, the vocational shop, and the farm shop. While it was worked out for shops in which the pupils must buy their own materials and supplies, the card also may be used to advantage in shops supplying free materials. In this latter case the records show what material was used and for what purpose it was used.

The use of this card delegates the responsibility of preliminary planning and recordkeeping, to the student, thus making the process educational. The boy, for instance, may gain the teacher's sanction to make a hog-shipping crate, a breakfast-nook set, a pair of andirons, a rope halter, an electric toaster, a bread pan, a meat-cutting board, or some other project. The pupil then makes a drawing of what he wants to construct, or he searches through available reference books or magazines for an appropriate design. This he presents to the teacher for approval. After the design has been O.K'd, the boy is given a job-record card (Fig. 1) which he proceeds to fill out, entering his name, name of project, date begun, source of design, and bill of materials. From a material and supplies price list, posted on the bulletin board, he computes the cost, enters that, and presents the job record to the teacher.

If satisfactory the teacher pencils his initials in the space "Design Approved" and issues the materials and supplies canceling the corresponding amount from the pupil's "Coupon card" (Fig. 2). The items purchased are checked in the "paid" column of the school account. The job number is entered, the coupon card clipped to the job record and filed.

In computing the finish, one cent a square foot may be charged for each coat of finish material applied, except that lacquer should be charged at two or three cents a square foot for each coat.

By totaling the board feet or square feet of surface and multiplying by the number of finish coats, the finish charge can be quite accurately ascertained. If the project is finished inside as well as outside, as a medicine cabinet might be, then the board feet are doubled before multiplying by the number of finish coats.

When the project is finished, the teacher examines it, and if it is up to standard, checks to see that the total school account is paid and certifies this by placing his initials in the space on the card provided for this purpose. He then records the grade in the space "Final grade," enters the date finished, time in hours if desired, totals the entire cost of the project and together with the pupil estimates the value of the completed project and enters it in the space provided at the lower right-hand corner.

The back of the card may be used to record any remarks or notations that will be useful in the future. The card is then complete and ready to file. The job number is an aid in filing and will indicate at a glance the type of work represented.

Each student in the shop has a number which corresponds with his bench number. This number is the prefix of the job number. All job numbers of student No. 16 will begin with 16. The next part of the job number is a letter including the type of work, as W for woodworking, F for forge work, S for sheet metal and soldering, etc. Following the letter representing the type of work is a number, such as 1, 2, 3, etc., showing that this is the first, second, third, etc., project a given student has made in that particular class of work, as woodworking, forge, or some other group. Following this another letter may appear to indicate whether the project was construction or repairwork — C or R. Thus a complete job number may be 16 W 3 C indicating that the card represents the third woodworking project which student No. 16 has constructed, rather than repaired.

The teacher finds this useful when student No. 16 selects his next project. If the aim of the course is to do a variety of work, the teacher can quickly tell from his file the kinds of work in which the boy has already had sufficient experience. The final grades under the job numbers will also tell the pupil's proficiency in a certain kind of work.

Each teacher will probably prefer to make his own key for job numbers. The following grouping is used by one teacher and is presented here as suggestive.

A — Auto mechanics and gas engines.
C — Cement and concrete.
E — Electric wiring.
F — Forge.
G — Glazing.
H — Harness and belting.
M — Machinery repair.
P — Pipe fitting and plumbing.
R — Rope.
S — Sheet metal and soldering.
T — Tool sharpening.
V — Vise work (cold-metal work).
W — Woodwork.
B — Building construction.

With repair jobs an evaluation of the unrepaired article should be listed in the bill of materials and charged under "Other Accounts." The cost of repairs is added to the original evaluation to figure total investment or total cost. Estimated value minus total cost gives the value of the repairwork. The value of the repairwork divided by the "time in hours" will show the earning rate for each hour spent on that particular job.

To avoid the need of the teacher running a cash-and-credit store for supplying materials to the student, the coupon card shown in Figure 2 is used. Each boy buys one or more of these coupon cards at the beginning of school and when one is canceled, he buys another, just as with meal tickets, railway commutation tickets, and the like. This reduces the money-handling transactions and keeps the cash income in unit amounts.

PUPIL: LAST NAME FIRST | SCHOOL SHOP — JOB RECORD | JOB NO.

PROJECT: | DATE BEGUN | DATE FINISHED | FINAL GRADE

QUANTITY	SIZE T	W	L	DESCRIPTION OF ITEM	KIND OF MATERIAL	UNIT BD. FT., ETC.	UNIT PRICE	COST PAID	SCHOOL ACCOUNT	OTHER ACCOUNTS
				USE OTHER SIDE FOR ADDITIONAL ITEMS ENTERING COST HERE.						

SOURCE OF DESIGN OR INFORMATION | DESIGN APPROVED | FINISH (PAINT, ETC.) | TOTALS

TOTAL SCHOOL ACCOUNT PAID | NOTE — DESIGN MUST BE APPROVED BEFORE WORK IS BEGUN. MATERIAL MUST BE PAID FOR WHEN ISSUED. POOR WORKMANSHIP FORFEITS PROJECT. | TOTAL TIME IN HOURS | TOTAL COST | ESTIMATED VALUE

A. H. Hausrath, Vocational Education Department, Iowa State College, Ames, Iowa

Fig. 1. Job Record Card

Pupil's Name | Bench No.

School Shop

Coupon Card

Complete Card $1.00
Half Card 50c

Not Valid Unless Signed by Teacher

Signature of Teacher

Date — Redeemable at Uncancelled Face Value.

To Be Kept by Teacher or by Stock Room Attendant.

Cross out values below if 50c card

10 5 5 2 2 2 2 2

Fig. 2. Coupon Card. Original size 3 x 4½ in.

This particular coupon card (Fig. 2) may be issued for $1 or for 50 cents as desired. By drawing a line through the two bottom rows of figures, 50 cents will be cut off. The writer prefers to use a ticket punch to cancel the values when materials are issued. There is less danger of error and the card shows its remaining value more clearly when a punch is used.

Whatever balance remains at the end of the course is refunded to the student. This eliminates the difficulty and trouble of collecting for projects after they have been completed, and obviates the shrinkage due to unfinished projects on which no accounts are available. There is probably some urge also for the pupil to be more careful of waste when he is constantly reminded that he is paying the bill.

The coupon system and an accurate project record showing the financial values, provide the pupils with the business training they should get as a part of their shop experience. It places the shop and the shop teacher on a better financial basis, and at all times furnishes an answer to the often-asked question, "Where does the money go?"

Switchboard work in the telephony class, Seneca Vocational High School. Photograph submitted by Hiram E. Greiner

General-shop Finding Courses[1]

G. N. Boone

Professor of Industrial Education,
McPherson College, McPherson, Kansas

Advantages and disadvantages of the general-shop course in the junior high school when used for exploratory purposes.

THE general-shop idea seems to have grown by such leaps and bounds that it demands the consideration and attention of all those interested in industrial arts and vocational education. That the general shop is of quite recent origin is shown by William E. Warner[2] who says: "The idea of the general shop is scarcely twenty years old and in its present development is less than ten years old. Examples of this type of organization are seen in almost every form and level of schoolwork. The program of many of the more modern elementary schools is now including what is called an 'activities' room or laboratory. Here youngsters of any of the grades may go to carry out special projects involving experimentation and manipulation of various materials and equipment not usually common to the standard classroom."

The general shop as used in this discussion differs somewhat from the activities room described by Mr. Warner. M. M. Proffitt[3] describes the nature and place of the general shop in the junior high school as follows: "The general shop, which is a recent type of organization for teaching elementary work in a number of shop activities under the direction and supervision of one individual, has been growing in favor, especially for some of the manual-arts work on the junior-high-school level. The number of schools adopting this general-shop plan has increased rapidly during the past two years. Of 1,500 representative school systems furnishing information to the Bureau of Education on this point, more than 40 per cent report that they have organized a general-shop course. More than 10 per cent of all the schools having general shops started them within this period.

What the General Shop Is

The majority of these general-shop courses are organized on the plan of a single comprehensive shop to include work in all the activities offered in the course, rather than on the basis of a cycle of shops, through which the students are routed as a group for a limited period of work in each activity. The comprehensive-shop plan makes it possible for a pupil to work continuously on a project involving more than one activity until it is completed.

Newkirk and Stoddard,[4] as well as other current writers, describe several variations of the general shop as follows:

1. The Single Comprehensive Shop — containing several types of plans:

a) Groups of students work at each type of equipment simultaneously and rotate through them.

b) Students work at only one type of equipment which is brought to the foreground. Types of work alternated.

2. The Modified General Shop (sometimes called the shop-cycle type) — a plan whereby the students are rotated through a series of related unit shops.

3. The Portable General Shop — a plan for transporting the teacher and equipment to a number of coöperating schools which share the expense.

Of the above, the first two are by far the most common and important.

For the purpose of discussion, the general shop may be defined as one which is fitted with special types of equipment for multiple types of work in more or less related fields, which activities may be carried on either simultaneously or in rotation.

Claims for General Shop

Promoters of the general shop have been profuse in their claims for its activities and purposes. A fairly complete list of the objectives of the general shop include:

1. General educational development — social habits and values.
2. Vocational exploration.
3. Avocational interests.
4. Motivation of curriculum — curricular integration.
5. Knowledge of industrial processes.
6. Handy-man values.
7. Consumer's appreciation.
8. Prevocational study and preparation.
9. Guidance values.

Activities of the General Shop

A wide variety of activities is revealed by the examination of the curricula of general shops in different school systems. Those which appear most common are:

1. Mechanical drawing
2. General woodwork
3. Machine shop
4. Foundry
5. Electricity
6. Sheet metal
7. Farm or community mechanics
8. Printing
9. Household mechanics
10. Arts and crafts
11. Auto mechanics
12. Leather work
13. Concrete
14. Ceramics

Activities which are to be included in the general-shop curriculum of a given community should be determined by the nature of the indigenous trades and industries as well as by the ability of the school to provide teachers and equipment.

M. M. Proffitt[5] says with reference to the selection of general-shop activities:

"1. Activities should be selected which include a variety of manipulative operations. There are too many industrial occupations in the modern world for a junior-high-school boy to make a study of any appreciable part of them. The only hope of realizing the exploratory and guidance objectives is to find a limited number of activities that will have some significance for the discovery of interests and aptitudes for various fields

[1]This article is a synopsis of a paper given before the Industrial Arts Supervision round table at the Kansas State Teachers Convention, Topeka, Kansas, November 7, 1930.

[2]William E. Warner, "Establishing the General Shop," INDUSTRIAL ARTS AND VOCATIONAL EDUCATION, August, 1930.

[3]Proffitt, M. M., "Industrial Education in 1924–26," United States Bureau of Education, Bulletin 1927, No. 29, Department of Interior, Washington, D. C.

[4]Newkirk and Stoddard, *The General Shop*, Manual Arts Press, Peoria, Ill., 1929.

[5]Proffitt, M. M., "The General Shop," *Educational Bulletin No. 30* (1929), U. S. Department of Interior.

of occupations. A study of trade and industrial occupations reveals that they require abilities: (*a*) In manipulative processes requiring different degrees of motor skill varying from the amount which an average person without specific training has as a minimum, up to a degree of skill which is acquired only after years of intensive training; (*b*) In knowledge of a technical nature including the ability to think about the work and to plan work in accordance with such knowledge. The technical knowledge needed also varies in accordance with the nature of the work.

"2. The selection of any trade activity for a general-shop curriculum should be based upon an analysis of the manipulative operations and technical knowledge included for the purpose of determining its value in accordance with 1.

"3. The shop activities should be of a character that will furnish opportunities for the development of types of manipulative abilities and technical knowledge similar to those needed for performing nonspecialized manual-industrial jobs of common occurrence in the maintenance of the home and in the performance of avocational and leisure-time activities.

"4. Shop activities and projects should be selected in accordance with the primary objectives for the industrial arts, and not in accordance with any indirect values they may have for other types of studies.

"5. Activities existing in the locality should have preference in the general-shop work insofar as these activities involve fundamental trades and industries."

Mr. Proffitt further states in the Bulletin referred to:

"For pupils of approximately 12 to 16 years of age chronologically, there is general agreement that good practice includes provision for developmental and exploratory experience in various human activities; that these experiences be on the interest and accomplishment levels of the pupils; that they provide for individual differences by means of enriched and differentiated curricula and methods of instruction; and that in addition to their immediate educational values they may serve for the discovery of interests and aptitudes that will have significance for determining a life interest."

Most industrial-education supervisors agree with Proffitt that the general-shop experience should be placed on the junior-high-school level. Many are extremely enthusiastic concerning what they think the general shop will do for pupils of these grades. Administrators have hailed the general shop as a cure-all for their educational ills, especially with reference to maladjustments to the formal curriculum. Vocational counselors have looked upon the general shop as a crystal ball into which they might gaze and find the students' fortune. The repertoire of advantages that have been claimed for the general shop include:

1. Contribution to general cultural education.
2. Exploratory and guidance opportunities for students.
3. Allows treatment for individual differences in students.
4. Economical for school with reference to rooms, teachers, and equipment.
5. Makes possible an adequate industrial-arts program for small schools.
6. Increases teacher efficiency.
7. Stimulates well-organized teaching matter, such as individual instruction sheets, etc.

Experience has already proved the futility of the general shop to accomplish all of these things, and the current magazine articles are making the following objections to the application of the general-shop idea:

1. Securing and keeping qualified teachers is almost impossible.
2. Difficulty of trying to demonstrate to one group while other groups are doing noisy work.
3. Increased number of preparations for one teacher.
4. Complexity of shop organization because of many kinds of tools, supplies, and equipment to be checked and cared for.
5. The very difficult task of trying to supervise a number of different kinds of work in the same room, at the same time, by one teacher.
6. Multiplicity of records necessary for checking the progress of every individual student and keeping him working "full steam ahead" all of the time.
7. "Junk shop" atmosphere rather than that of the one-unit shop, which tends to foster the attitude of "puttering."

Without doubt many of these claimed advantages and disadvantages are valid, and bear evidence to the fact that not all of the practical problems concerning the general shop have been satisfactorily settled.

There are many phases of the general shop that have been mentioned above for the purposes of familiarizing the reader with its nature and possibilities that are beyond the scope of this treatise, since we are herewith interested in the application of the general shop as an exploratory procedure.

The General Shop as an Exploratory Experience

It has been seen that Proffitt places much emphasis upon the possibilities of the general shop as exploratory experiences. The author has made considerable study of instances of this exploratory stress and will mention here a few cases.

G. F. Weber, director of vocational education in South Bend, Indiana, reports thus with regard to their organization: "In our larger schools we have as many as four shops devoted to seventh- and eighth-grade work. The first shop takes care of printing and mechanical drawing; the second, machine shop and forging; the third, woodshop and sheet metal; and the fourth, electricity and automobile work. In our very small schools one man assumes charge of eight units, all arranged in one room, with three to five boys working in any one unit at any one time. After experimenting with general shop for ten years, my own notion is that it will succeed only if backed up with good instructors and well-prepared instruction sheets. We are very enthusiastic about the results obtained from this exploratory type of organization."

J. V. Hamilton, director of the Trade School, Chanute, Kansas, in his trade-school bulletin says: "The prevocational or finding courses are offered in the junior high school covering each line of work offered in the trade school and to each the student devotes five 60-minute periods each week during one-half year to each of the following subjects: home mechanics, elementary mechanical-drawing art, woodworking, sheet metal, electricity, auto mechanics, vocational agriculture, and printing. At the close of the junior-high-school course the student is able to choose the vocational work he likes and can do best. In the senior high school he can begin specializing in his chosen line of work. At the conclusion of this period of specialization the students are graduated with a thorough knowledge of the use of tools, well along with their apprenticeship training and able to go out and take their places as honorable producers in industry."

The author has also observed the exploratory phase of the general shop being practiced in many industrial types of schools. Some notable examples are the Haskell Institute for Indians at Lawrence, Kansas, and the California State School for Boys at Whittier, California. In these institutions, as well as many others of a similar nature, the boy is put through a curriculum of exploratory courses to determine his aptitudes and interests as a basis of helping him to select some trade in which he is to specialize. In each instance the administrators are enthusiastic concerning the exploratory results being obtained.

Dr. Norman Fenton,[6] director of California Bureau of Juvenile Research, says: "The Whittier State School for Boys introduced a general shop in the fall of 1928, offering the possibility of trying the boy out in eleven occupations. All boys get about a week's trial instruction in each of these trades. The classes are never over fifteen. The director of the general shop, who was trained especially for this work in one of the Calif-

[6]Fenton, Norman J., Bulletin No. 7, Whittier State Schools, Whittier, California.

ornia state teachers' colleges, is able to observe and to report upon the vocational aptitudes of the boys from first-hand observation of them at work. In addition to this actual trial of the boy at work, the vocational interests of the boy are studied by the vocational director and the psychologists of the research department. On the basis of these findings and in consideration of the boy's interests and the vocational opportunities which will probably be open to him when he leaves the Whittier State School, a trade assignment is made. If the first assignment proves to be incorrect, a change is made later. One basic feature of the Whittier Plan is its flexibility. No program for a boy is ever considered final and inflexible; it is always subject to modification if that seems advisable."

The length of the exploratory courses in the institutions just cited vary considerably. In the Whittier plan each course covers only about a week's time and yet they believe enough can be determined in that very short period to justify a decision for specialization, subject, of course, to later readjustment if such seems expedient.

Paul Chapman,[7] director of vocational education, State of Georgia, and former president of the American Vocational Association, has said that he believes every boy of junior-high-school level should have the opportunity of short exploratory courses to the end that he may find those activities in which he is most interested and for which he seems best adapted.

These illustrations of practical use of the general shop as a finding-course procedure, together with the indorsements of the leaders who believe such procedure successful, are given to support the thesis that the exploratory feature of the general shop is of real value. It is reasonable to assume, however, that better results will be obtained under the direction of an expert teacher together with the combined efforts of administrators, vocational directors, and psychologists of the research departments where such are available.

It would be only fair to state that some have failed to secure satisfactory results with the general shop on the exploratory basis. Various reasons have been given, many of which have been previously enumerated as objections to the general shop itself. Perhaps the most common criticism of the exploratory values of the general shop is that the length of time given to each unit is too short to give significant results. Frank T. Fee,[8] director of industrial education, Hutchinson, Kansas, and sometime president of the Kansas Vocational Association, states: "I feel that the big mistake that is being made generally in our so-called exploratory courses is that there are not adequate facilities for continuing the training after a boy does find something in which he is interested. Too many schools are setting up elaborate 'finding' courses in the junior high school, and little, if any provision made for intensive training in later grades. As a result the only thing a boy 'finds' is that he is at the end of his rope after a mere introduction."

And so arguments for and against the exploratory phase of the general shop might be multiplied almost indefinitely with little avail. It remains a fact that the general-shop idea is growing rapidly and also that many are testifying that their experience with it as a finding-course procedure justifies its use.

Walter G. Beach,[9] of Stanford University, referring to vocational education, says: "The farm and apprenticeship system previously had been the chief means of training for industry, but with the coming of machinery and the consequent growth of cities these means of training no longer accomplish their former result. It therefore began to be demanded that the school should fit youth for industry and hence its curriculum should be in part industrial-educational."

It seems to follow that if modern youth cannot gain exploratory experiences from industry itself, society then demands that the schools provide for this lack of training. The general shop at present appears to be the best means for giving this finding experience upon which to build the subsequent structure of specialized trade training.

[7]This statement was made by Mr. Chapman in a speech made before the Kansas Vocational Association at Topeka, Kansas, November 7, 1930.

[8]Quoted from personal letter to author, November, 1930.

[9]Beach, *An Introduction to Sociology and Social Problems*, Houghton Mifflin Company, Chicago, 1925, p. 341.

Vocational Auto Mechanics

Harry C. Hurlbut

Abraham Lincoln High School,
Los Angeles, Calif.

A definitely planned shop organization which imposes a maximum amount of responsibility on the student and accustoms him to assuming his part in an efficient shop routine.

MOST vocational auto shops rely on outside jobs for the students to work on. The problems that confront the teacher of such classes cannot be appreciated by one who has never faced them. In addition to the usual school problems that confront all vocational teachers, the auto-shop instructor has all the problems of a commercial repair shop; the handling of the customers; the locating of troubles; the ordering of parts and materials; the bookkeeping connected with each job; the testing of the cars; and last but not least, the responsibility of turning out first-class production work on expensive automobiles with nothing but young learners who cannot be "canned" if they do not come up to standard. This is why some school shops are organized with the teacher as the central figure carrying on the activity with the aid of the students.

A close analysis of the principles of vocational education, however, reveals that such an organization cannot produce the best results. We sometimes need to review these principles in order to keep on the right track. Briefly stated, they are as follows: Vocational education consists of trade knowledge *applied* and trade experiences *repeated* until they have become an organic part of the student's life. Consequently, to be efficient, the school shop should supply the student with all the essential trade information, and offer opportunities to use this information and to develop sufficient skill to take his place in industry. While the student's vocational training should give him all the trade knowledge he will need to know, it should not clog his mind with nonessentials. Likewise, while his training should develop the skills he will need to use, it should not train him in obsolete methods or in useless jobs, such as he will not need to perform in industry. He must accustom himself to, and become a part of, an efficient shop organization. And if he possesses executive ability, he should have an opportunity to develop it while learning his trade.

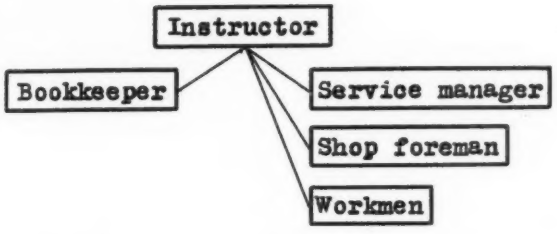
In order to increase the efficiency of the auto shop and to make it more closely parallel the commercial shops, the following shop organization has been used at the Abraham Lincoln High School in Los Angeles for the past three years.

This shop organization was evolved around the principle that the activity in its entirety was to be carried on by the students with the teacher acting as a supervisor. It was first tried as an experiment and has been found to produce the following results:

1. It develops leadership in those students who have executive ability.
2. It develops initiative in the majority of students.
3. It develops zeal and creates a greater interest in the student's work.
4. It acquaints the students with commercial shop organizations and practices.
5. It relieves the instructor of much detail work.
6. It provides greater opportunity for the instructor to give individual instruction on the job where needed.
7. It insures the uninterrupted work of the class while the instructor is giving individual instruction.
8. It enables the instructor to supervise and direct the entire shop activity with greater efficiency.
9. It integrates instruction in principles with experience in application of those principles, and thus develops reasoning power and self-reliance.

The Shop Organization

The organization of the school auto shop is patterned after commercial garage organizations. All jobs performed are of a practical commercial nature. All shop activities are carried on by the students, and directed by the instructor. The personnel organization of the school is as follows:



The service manager and the shop foreman wear white coats with the words SERVICE MANAGER or SHOP FOREMAN in red letters across their shoulders. The workmen wear coveralls. The service manager, foreman, and bookkeeper are appointed by the instructor. Only those students who show promising executive ability for their respective positions are chosen. Any shop executive who fails to demonstrate his ability to perform his duties, is immediately removed and given more time to develop, before again being offered the opportunity as an executive. Each executive is appointed for eight weeks but may be reappointed at some later time. Each incoming executive serves one week under the direction of the outgoing executive before assuming his duties.

The specific duties of the different executives and of the student workmen are listed on separate instruction sheets. These instruction sheets are given to each student for the following purposes:

1. That each student may know his own duties.
2. That each student may know the duties of the various other students.
3. That each student may know his relation to the various shop executives and to the workmen.

In addition, the following instruction sheets are also given to each student:

Order of the day, rules for bringing work into the shop, sample outline of trade technical information, route of the automobile through the shop.

These instruction sheets are given to the students for the following purposes:

1. To inform the students under what conditions work may be brought into the shop.
2. To guide the students in securing the necessary information in preparation for the job.
3. To give the students a better understanding of the shop organization and procedure of work.
4. To give the students a vision of the aim and scope of the shop organization.

Order of the Day

1. Roll call in classroom.
2. Classroom work: (*a*) talks about shop problems; (*b*) talks about jobs in the shop; (*c*) lessons; (*d*) group planning or conferences.
3. Report to the shop for work.
4. Change clothes.
5. Start job.
6. Work until time to clean up.
7. Pass at passing time.

Duties of the Service Manager

1. Meet all customers courteously in a businesslike manner.
2. Explain to the customers the conditions under which work is taken into the shop.
3. Write the work orders and secure the customers' signatures.
4. Give the work orders to the foreman with any additional verbal instructions.
5. Assist the foreman in ordering parts for the jobs.
6. Test each completed job after the foreman has O.K'd it and sign name on the work order if the job is satisfactory.
7. Keep a record of each student's progress and accomplishments on the master record chart.
8. Be responsible for students' cleaning up and passing at the proper time.
9. Assist the instructor in supervision of the shop regarding cleanliness, orderly appearance, and discipline.
10. Consult with the instructor whenever in doubt regarding the discharge of any of the above duties.

Duties of the Shop Foreman

General Duties

1. Be responsible for all workmen in the shop.
2. Be responsible for all jobs in the shop.
3. Coöperate with the service manager and with the instructor in supervision of the shop regarding cleanliness, orderly appearance, and the discipline of students.

Specific Duties

1. Read the work orders carefully.
2. Assign students to jobs.
3. See that each student has a job.
4. Report to the instructor the lack of work for any student.
5. Before each student starts on any job, inspect his written lists of technical information for the instructor's O.K.
6. Test and inspect each part of the job as it progresses.
7. Consult with the service manager regarding parts needed for the various jobs.
8. Give parts order to the bookkeeper.
9. Write orders in duplicate for any material needed from the stockroom. Give one copy to the workman and the other copy to the bookkeeper.
10. Give a final test to the job when completed, and sign name on the work order.
11. Notify the service manager and the bookkeeper when the job is completed.
12. Consult with the instructor whenever in doubt regarding the discharge of any of the above duties.

Duties of the Bookkeeper

1. Call class roll.
2. Write purchase orders for parts as directed by the foreman.
3. Enter all parts purchased on the job cards.
4. Enter all material drawn from the stockroom on the job cards.
5. Make bills for completed jobs.
6. Present bills to customers. Make all explanations in a courteous, businesslike manner.
7. Collect money and issue receipts.
8. Keep the shop books.
9. Answer telephone calls.
10. Be responsible for all library books in the shop library.
11. Assist the instructor whenever necessary in any clerical work.
12. Consult with the instructor whenever in doubt regarding the discharge of any of the above duties.

Duties of the Workmen

1. Report to the classroom for roll call.
2. Dress for shopwork as soon as dismissed from classroom.

3. Report on the job, or to the foreman, if out of a job.
4. Read the work order as soon as assigned a job.
5. Sign name on the work order beside the job to be worked upon.
6. Report to the instructor if in need of instruction.
7. Prepare the following lists of information, in preparation for the job:
a) The necessary job operations in their proper sequence.
b) The adjustments, clearances, and other necessary technical data.
c) The special tools that will be needed.
d) The material and supplies that will be needed.
e) The flat-rate time schedule for performing the job.
8. Secure the instructor's O.K. on the written lists of information and show to the foreman before starting to work.
9. Perform the job assigned.
10. Have each part of the job inspected by the foreman or the instructor as the work progresses.
11. Report to the foreman whenever any material is needed from the stockroom. He will write and sign the necessary requisition.
12. Lock all parts removed from the car in lockers provided for that purpose, and write the locker number on the work order.
13. Each student will receive ten brass tool checks, for which he will be responsible.
14. Workmen will give checks to the toolroom man for all tools drawn from the toolroom.
15. Clean all tools before returning them to the toolroom.
16. Keep the floor neat and clean around the job.
17. Keep the workbenches clean.
18. See that the car, inside and outside, is kept clean.
19. Notify the foreman whenever:
a) Parts are needed.
b) Job operations are ready to be tested.
c) There is any unusual occurrence on the job.
d) There is any obstacle encountered.
20. Report to the foreman as soon as the job is completed.

The Essential Trade Technical Information

The auto mechanic must possess the following trade technical information relative to each job before he can properly perform the work:

1. The steps or operations necessary to perform the job.
2. The sequence in which these operations must be performed.
3. The safety precautions which should be taken while performing the job.
4. The adjustments, clearances, or other technical data peculiar to the job.
5. The special tools or equipment that are needed to perform the job most effectively and easily.
6. The different kinds of supplies and materials that are needed to perform the job.
7. The flat-rate time schedule for performing the job.

To be of greatest value, this trade technical information should be taught to the student at the time of assignment of the job.

Method of Teaching the Trade Technical Information

After the student has been assigned a new job, he is given written instructions relative to the work to be performed. These instructions include the essential information which the student will need, and are derived from the following sources:

1. Service manuals furnished by the manufacturer.
2. Instruction books furnished by the manufacturer.
3. Authentic articles which have been cut from trade magazines or other sources, and which have been filed and indexed for this purpose.
4. Flat-rate manuals.
5. Instruction sheets which have been written by the instructor.

After reading the instructions the student prepares the following lists as necessary preparation for the job:

List No. 1 includes the necessary job operations in their proper sequence.

List No. 2 includes the adjustments, clearances, and other technical data he will need to know.

List No. 3 includes the special tools he will use.

List No. 4 includes the materials and supplies he will need.

List No. 5 states the flat-rate time in which the job should be performed.

These lists are handed to the instructor who reads them and confers with the student about the job. The instructor may supplement these lists of information with further instructions if necessary. When the instructor is satisfied that the student has sufficient knowledge for the job, the student is authorized to proceed with the work.

Advantages of this Method of Teaching the Trade Technical Information

1. The student studies the job before he performs it.
2. The student knows just what he is going to do, and the order in which he is going to do it.
3. The student learns the proper fits, clearances, and adjustments which he will need to make, before attempting to make them.
4. By writing down the necessary operations in their proper order, they are more firmly fixed in the student's mind.
5. Much lost time is prevented at the toolroom window by the student having a correct list of the tools and materials he will need to use.
6. Knowledge of the commercial time required to perform the job gives the student a goal to work toward.
7. The student's outline of job operations reveals to the instructor if the student has sufficient knowledge of the job to attempt it.
8. The student's outline of the job also reveals to the instructor what further instruction the student needs before he performs the job.

What This Method of Instruction Has Accomplished

1. The actual speeding up of work in the shop.
2. Saving of student's time waiting for the instructor to show them what to do.
3. The performance of each job in a more thorough and workmanlike manner.
4. More efficient instruction, and greater self-reliance on the part of the students.

Sample Outline of Trade Technical Information

JOB NO. DATE
JOB .....
MAKE AND MODEL OF CAR Adjust valve tappets
WORK ORDER NO. Hudson 1928
.....
.....

SEQUENCE OF JOB OPERATIONS:

1. Run motor until warm.
2. Raise right side of hood.
3. Remove carburetor hot-air pipe.
4. Remove cylinder side plates.
5. Turn crankshaft until No. 1 piston is on firing dead center.
6. Loosen tappet adjusting screw lock nut on No. 1 exhaust-valve tappet.
7. Holding the lock nut with one wrench, use other wrench to turn adjusting screw.
8. Tighten lock nut.
9. Adjust No. 1 intake-valve tappet in the same manner.
10. In the same manner adjust all the other tappets having the corresponding piston on firing dead center.
11. Tighten lock nuts securely.
12. Replace cylinder side plate.
13. Replace carburetor hot-air pipe.
14. Lower hood.

ADJUSTMENTS AND DATA
Intake tappets, .004
Exhaust tappets, .006
Firing order, 1-5-3-6-2-4

SPECIAL TOOLS NEEDED
Tappet adjusting wrenches.
Thickness gauge.

MATERIAL NEEDED
None.

COMMERCIAL TIME
½ hour.

Route of Automobile Through Auto Shop

The student service manager meets the customer and discusses the work to be done. He also explains to the customer under what conditions the work will be accepted. He then writes out the work order (consulting with the instructor if necessary) and has it signed by the customer. This forms the customer's sign, agreeing to the conditions which are written thereon.

The work order is then turned over to the foreman, who reads it and then assigns the job to a student. If necessary, the foreman discusses the assignment with the instructor.

The student workman then proceeds with the job in the following manner: First, he reads the work order and signs his name to the job he is to perform. Second, he secures the necessary instructions for doing the job and studies them. Third, he writes the necessary job operations in their proper sequence, and makes notes on any adjustments, clearances, or other essential data needed to perform the job. Fourth, he secures the instructor's O.K. on the foregoing. Fifth, he proceeds with the job.

As the work progresses, the foreman makes inspections and tests from time to time, consulting with the instructor when necessary.

When the job is completed, the workman reports to the foreman. After he has approved the job, the foreman also signs the work order. The service manager who talked to the customer and who wrote out the work order, then tests the car (with the aid of the instructor, if necessary) and O.K's the work.

All parts and materials used on the car are then entered on the job ticket by the bookkeeper, after which the bill is written out for the customer.

The bookkeeper presents the owner with the bill and receives payment, giving the owner a receipt in return, after which the car can be released from the shop.

Training for the Building Trades

Nelson L. Burbank

Vocational High School, Cincinnati, Ohio

Strict trade specialization, as was customary in the past, is no longer feasible. The future requires journeymen versed in several trades.

THERE are thirty major trades in the building-construction industries. Training activities, in organized school classes, are offered to journeymen, apprentices, and preapprentices in hundreds of cities throughout the nation.

The following list gives the major trades, number of cities offering training in each trade, and number of states in which these cities are located.

A study of this list reveals the extensive program of instruction. A close analysis of certain trades will bring out many points of similarity, one with another. Since the instruction program is extensive, certain trades akin in performances and the demand for trained specialists less than ever before, could not the training for many trades be combined? Could not kindred trades be taught together so that the worker would be more in demand — not jack-of-all-trades, but master of kindred trades whose services would be in much greater demand than a one-trade specialist?

Major Trades	*Cities*	*States*
1. Asbestos workers	37	12
2. Bricklaying	76	23
3. Carpentry	238	48
4. Cement finishing	4	3
5. Electrical work	363	47
6. Electrical-fixture hanging	363	47
7. Elevator construction	18	11
8. Furnace setting	37	12
9. Glazing	37	12
10. Hod carrying	0	0
11. Hoisting engineering	37	12
12. Iron working (ornamental)	2	1
13. Iron working (structural)	2	2
14. Laboring (common)	0	0
15. Lathing	37	12
16. Marble setting	4	2
17. Painting	62	25
18. Plastering	19	9
19. Plumbing	162	31
20. Rodmen	2	2
21. Roofing (composition)	0	0
22. Roofing (slate)	0	0
23. Roofing (tile)	0	0
24. Sheet-metal work	142	31
25. Steam fitting	27	17
26. Stone cutting	4	4
27. Stone masonry	4	4
28. Stone setting	4	4
29. Terrazzo work	2	1
30. Tile setting	2	1

The following list classifies the 30 major trades into 12 groups, for group instruction. Laboring and hod carrying not included.

A. *Asbestos trades*
   Asbestos work
B. *Carpentry trades*
   Carpentry
C. *Glazing trades*
   Glazing
D. *Heating trades*
   Furnace setting
E. *Hoisting engineering*
   Hoisting trades
F. *Lathing trades*
   Lathing
G. *Mechanical trades*
   Electrical work
   Electrical-fixture hanging
   Plumbing
   Steam fitting
   Elevator construction
H. *Metal trades*
   Rodmen
   Structural iron work
   Ornamental iron work
I. *Painting trades*
   Painting
J. *Roofing trades*
   Roofing (composition)
   Roofing (slate)
   Roofing (tile)
K. *Sheet-metal trades*
   Sheet-metal work
L. *Trowel trades*
   Bricklaying
   Cement finishing
   Marble setting
   Plastering
   Stone masonry
   Tile setting
   Terrazzo work
   Stone cutting
   Stone setting

Trained journeymen versed in several trades would at once have distinct advantages over others, some of which are:

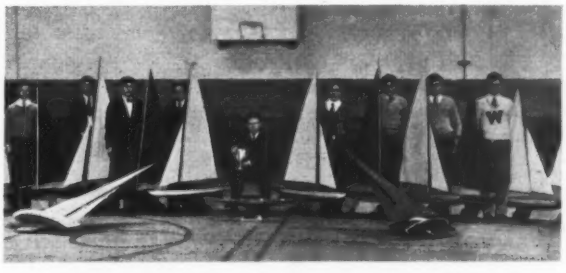
A. Days of employment per year would be greater.

B. More master mechanics would be needed.

C. Unfit or unsuited workers would be eliminated.

Regrouping and combining of allied skills and technical information would be possible by careful study on the part of the present teaching corps.

The entire construction field would benefit by greater coördination and coöperation.



Members of the Model Yacht Club, Senior High School, Watertown, Mass. Mr. John Black, instructor

An Elementary Printing Course

Earle L. Hadley

Pasadena, California

This outline of instruction covers a ten-week exploratory course in hand composition on the junior-high-school level.

Prerequisites: Knowledge of English grammar and composition, spelling, word division, punctuation, and simple arithmetical processes.

I

Instruction units involving simple straight-matter composition; use of stick; use of spaces and quads; use of leads and slugs.

Characteristics of type.
Learning lay of case.
Similar characters.
Use of composing stick.
Locating spaces and quads.
Standard spaces and quads.
Reading type matter.
Use of spaces in composition.
Straight composition.

Objective

Ability to read copy, set stick, space and justify lines, spell and divide words, punctuate properly, use spaces and quads, understand and use trade terms.

Knowledge of English grammar and composition, spelling, word division, punctuation, body-type sizes, lay of case, reason for use of stick, necessity for care in the use of type and stick, reasons and necessity for proper justification, principles of spacing.

Technical Information

Trade mathematics: Understand and apply the principles of justification, based on the point system.

Trade science: Know the processes of manufacture (physical and chemical) of type, spaces, and quads, and the relation of these processes to proper justification.

Trade English: Proper use of dictionary.

Auxiliary Information

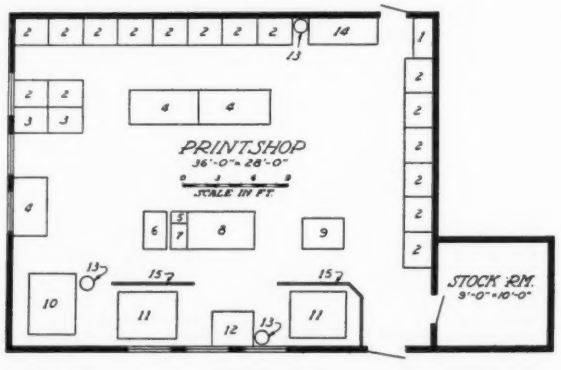
Trade terms: Tools and machines, composing stick and composing rule.

Materials: Type, nick, feet, face, shoulder, counter, beard, body, pin mark; quads — en, em, 2-em, 3-em; spaces — 3-em, 4-em, 5-em, thick, thin, hair, copper, brass; serif, kern, shank, roman, cap, lower case, hand set, straight matter.

Operations: Compose, composition, set, reset, justify, justification, space.

Miscellaneous: Leaded, solid, off its feet, compositor, composing room.

Care and use of tools: Care of the composing stick; do not drop on floor; see that stick is not sprung by too tight justification; keep clean. Use of composing rule; do not scrape face of type; do not push type or spaces into tight line; see that case is secure on rack.



1. Closet
2. Working Benches
3. Dustproof Cabinets
4. Tables
5. Inkstand
6. Proof Press
7. Galley Rack
8. Imposing Table
9. Teacher's Desk
10. Cutter
11. Presses
12. Drying Rack
13. Wastepaper Cans
14. Washstands
15. Fence Guards for Presses

II

Instruction units involving sorting and distributing leads, slugs, rules, furniture, and type; making corrections; use of line gauge; washing and cleaning materials used; division of words; centering of lines; indentions.

Indentions.
Centering lines.
Division of words.
Use of line gauge.
Washing type forms.
Sorting leads, slugs, rules, furniture.
Distribution.

Objective

Ability to distinguish spacing materials other than quads and spaces; use line gauge; sort spacing material and rules, and distribute same; wash type forms; clean rules and spacing material; understand and use correctly all trade terms connected with this work; make corrections in own work.

Knowledge of the necessity for care in handling accurately made materials; reasons for processes involved; reasons for care in handling type forms; effects of cleaning materials.

Technical Information

Trade science: Know the reaction of cleaning materials; know the properties of materials used in various kinds of spacing material and why they are used (to secure accuracy and durability); know the effects of water on reglets and wood furniture.

Auxiliary Information

Trade terms: Line gauge, galley, benzine brush, benzine can, case, rack, cabinet, bank, stand, frame, dump, hell box, sponge.

Materials: Leads, slugs, reglets, furniture (wood, iron, metal), form, type, rule, dead matter, live matter, pi, lye, cleankut, benzine.

Operations: Distribute, distribution, sort, wash a form, transfer a form.

Miscellaneous: Line gauge, nonpareil, pica, bastard size.

Care and use of tools: Use care not to drop tools, type, rules, or spacing materials on concrete floors.

Safety precautions: Be careful in the use of lye for the cleaning of forms; keep inflammable fluids away from flames; dispose of rags and other inflammable materials in proper manner.

Knowledge of: Recognize various kinds of spacing material, and cleaning agents.

III

Instruction unit involving taking press proof only, and of cleaning type.

Taking press proofs.
Cleaning rules and spacing material.

Objective

Ability to make corrections in own form; take press proofs.

Knowledge of working principles of proof presses; proof paper; use of proper ink for proofs.

Auxiliary Information

Trade terms: Stone, galley, proof press, brayer, ink slab, spatula.

Materials: Proof paper, dry proof paper, news print, ink.

Operations: Take, pull, a proof.

Care and use of tools: Wash type forms after taking a proof, wash and hang up brayer; wash ink slab and spatula.

Knowledge of: Know kinds of paper to use for proofing; know how to use; know kinds of ink to use for proofs.

Equipment Suggested for a Junior High School for a Period of Ten Weeks — Sixteen Pupils

1 12 by 18-in. job press, with single disk, combined gear and pinion guard, 3 semisteel chases, 6 roller cores, 6 roller trucks, vibrator roller, and wrenches.
1 12 by 18-in. press brake.
1 12 by 18 full-length ink fountain.
1 12 by 18-in. motor bracket and 26-in. drive pulley.
1 Set of three cast rollers.
1 Motor belt for 12 by 18-in. press, 9-ft. by 2-in., endless leather.
1 ½-h.p. motor with variable-speed controller — 220 volts a.c., 50 or 60 cycles, single-phase.
1 10 by 15-in. job press with full equipment.
1 26-in. paper cutter.
1 Platen-pressroom cabinet (wood with steel top).
1 Imposing table with steel top and wood frame with drawers, slides, chase rack, labor-saving wood furniture, including reglets, 10 to 60 ems.
1 Extension-front cabinet (wood) with 48 full-sized cases with special top and lead and slug cases, complete with leads and slugs.
1 Lead and rule cutter.
2 doz. Spring-tongue gauge pins.
1 doz. Wood line gauges; pica, nonpareil, and inch measurement.
6 2 by 12-in. all-measure job composing sticks.
16 12-em news sticks.
16 Single-tier case stands, with 6 California job cases for each stand.
2 1-quart size benzine cans.
1 Nurex tabbing pot with cement brush.
1 8-in. round-end ink spatula.
6 Compositor's tweezers.
1 3½ by 8-in. proof planer.
1 3 by 6-in. hickory mallet.
1 Quoin key.
2 doz. Quoins.
2 5-Wheel numbering machines.
1 Pedestal staple binder, capacity two sheets to 3/8 inch, flate and saddle-back stitching.
1 Galley proof press, size 10¼ by 32 in. (bed measurement).
16 12-em composing rules.
Border and ornaments to suit the shop being installed.
1 Font 12-point typewriter type, Remington No. 2, 100a lower case, 20A caps.
2 Fonts metal furniture (iron) from 4 to 25 ems.
1 Case brass rule, hairline (2-point body).
1 Case brass rule, 1-point face on 2-point body.
12 Steel galleys 2½ by 23 in.
6 Galleys (medium size, brass, for ad work).
2 Galleys (large size, brass, for ad work).
1 Pair bellows.

Type

Invitations Text, two job fonts each of 10, 12, 18, 24, and 30 point.

Waldorf Text, one job font each of 14, 18, 24, and 36 point.

Century Expanded Lightface, one job font each of 12, 18, 24, 36, and 48 point.

Century Bold, one job font each of 12, 18, 24, 36, 48, 60, and 72 point.

Century Bold Italic, one job font each of 12, 18, 24, 36, 48, 60, and 72 point.

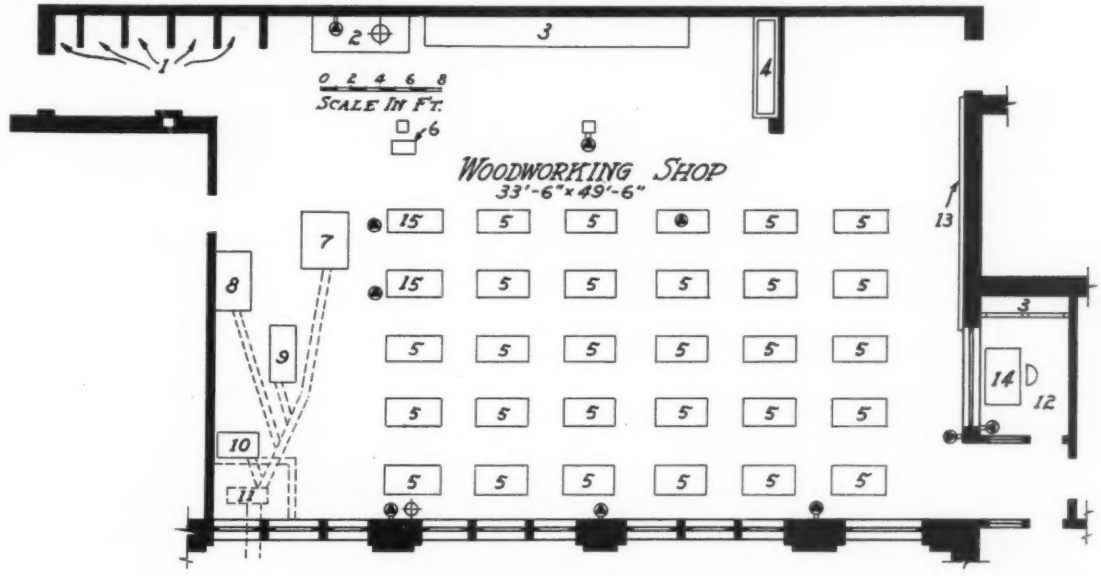
Century Expanded Italic, one job font each of 12, 18, 24, and 36 point.

200 lb. 10-point Century Expanded.

50 lb. 10-point spaces and quads.

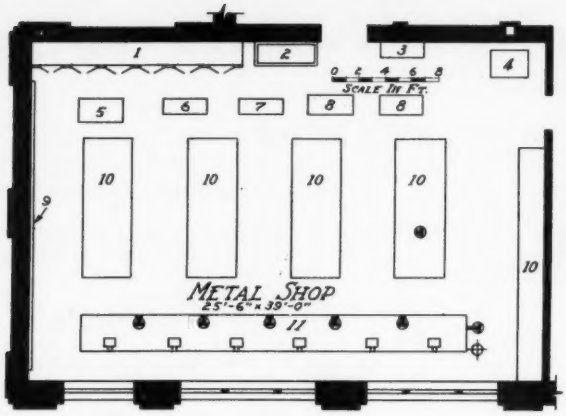
30 lb. each, spaces and quads, 12, 18, 24, and 36 point.

SHOP LAYOUTS



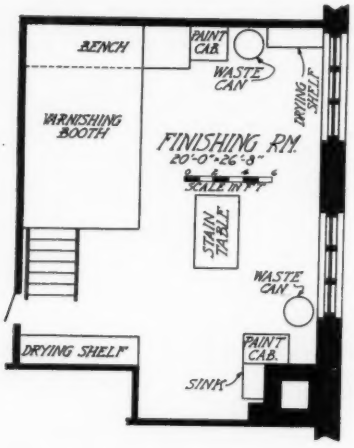
Wilson Junior High School, Hamilton, Ohio

1. Lumber Rack
2. Glue Table
3. Storage Cupboard
4. Wash Sink
5. Workbench
6. Grinder
7. Arbor Saw
8. Jointer
9. Planer
10. Band Saw
11. Motor
12. Office
13. Blackboard
14. Instructor's Desk
15. Lathe



Wilson Junior High School, Hamilton, Ohio

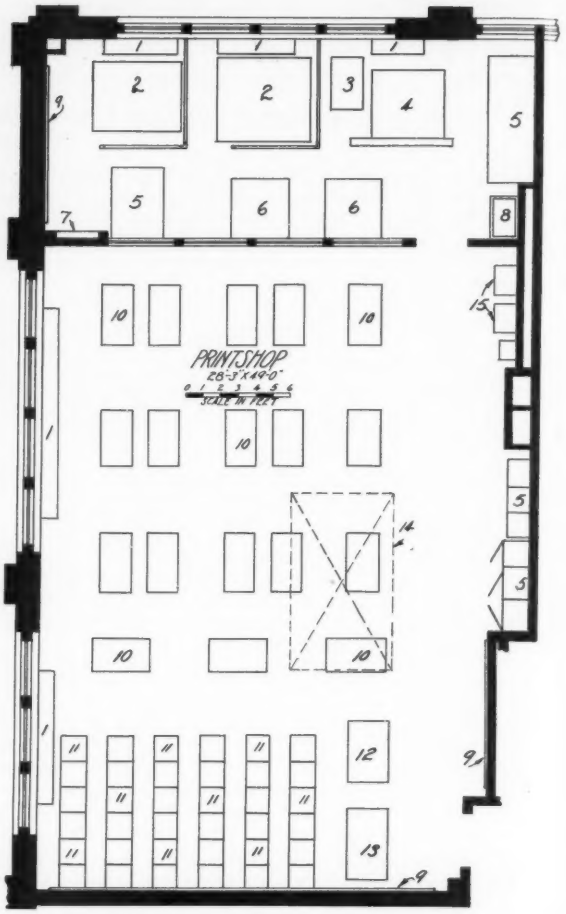
1. Storage Cupboard
2. Wash Sink
3. Lathe
4. Forge
5. Shear
6. Bar Folder
7. Forming Machine
8. Stake Holders
9. Blackboard
10. Workbenches
11. Machine Bench

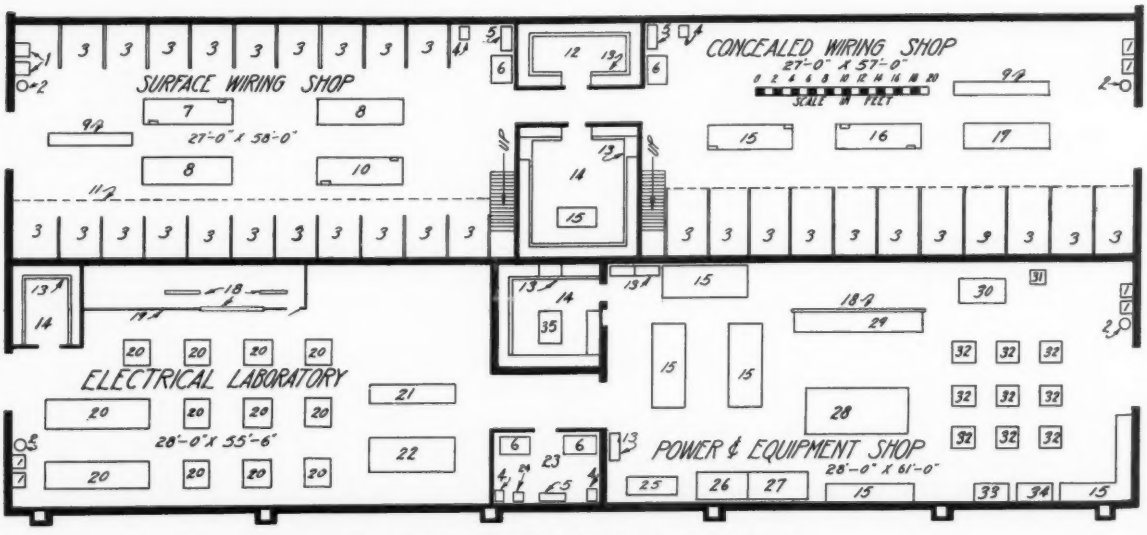


Left — *Appleton Vocational School, Appleton, Wisconsin*

Right — *Folwell Junior High School, Minneapolis, Minn.*

1. Radiator
2. Press
3. Pilot Press
4. Paper Cutter
5. Cabinet
6. Imposing Table
7. Electric Cabinet
8. Sink
9. Blackboard
10. Double Type Stands
11. Opera Chairs
12. Teacher's Desk
13. Worktable
14. Skylight
15. Washbasin





Connelley Trade School, Pittsburgh, Pennsylvania

1. Washbasins
2. Drinking Fountain
3. Wiring Booths
4. File
5. Bookcase
6. Desk
7. Conduit
8. Soldering Table
9. Pipe Rack
10. Metal Wire Molding Table
11. Balcony
12. Supply Room
13. Steel Shelving
14. Toolroom
15. Workbench
16. Wire Mold and Metal Molding Table
17. Conduit and Soldering Table
18. Switchboards
19. Screen Rail
20. Concrete Foundation
21. Meter Test Table
22. Measurement Table
23. Office
24. Locker
25. Lathe
26. Loop Winder
27. Coil Shaper
28. Motor Storage Rack
29. Rubber Mat
30. M. G. Set
31. Arbor Press
32. Worktables
33. Shears
34. Grinder
35. Table

WHAT OTHERS ARE DOING

Industrial Education at Fordson

A. C. Tagg

Director of Industrial Education,
Fordson Public Schools,
Dearborn, Michigan

The industrial-arts and vocational-education work offered in the junior and senior high schools of a small community, the population of which is engaged in many types of industrial pursuits.

THE Fordson junior and senior high schools are strictly cosmopolitan, opposed in their aim and objective to segregation of students except for special adjustment. Under our plan, students enrolled as junior-high-school pupils, regardless of their classification, have equal opportunity to take part in all school activities. It is obvious that this is going to help further the democratic principles of American democracy and do away with any feeling of inferiority on the part of a person engaged in preparing for entry into an occupation. On the other hand, college-preparatory students attending a cosmopolitan high school will hold those students preparing for occupations and work in higher esteem and respect. Industrial students attend the same classes for academic work.

The industrial-education department feels that it has a social responsibility which demands that it serve the community and each individual.

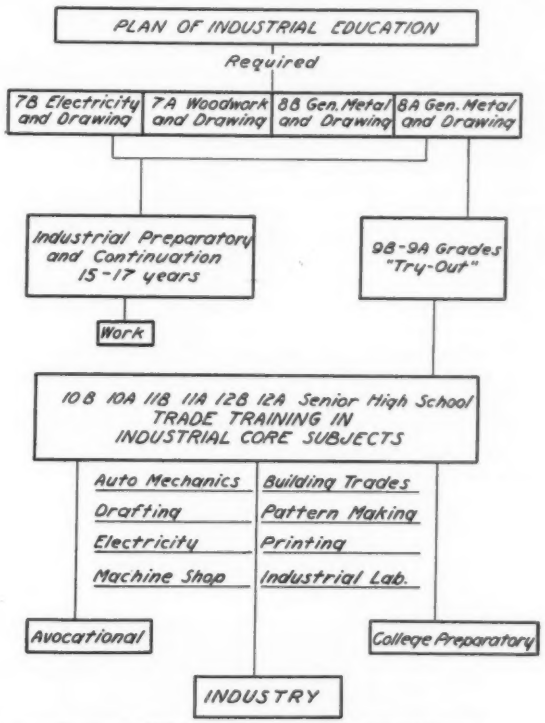
Our first assumption is that industrial education is not a special subject but rather a necessary unit of general education.

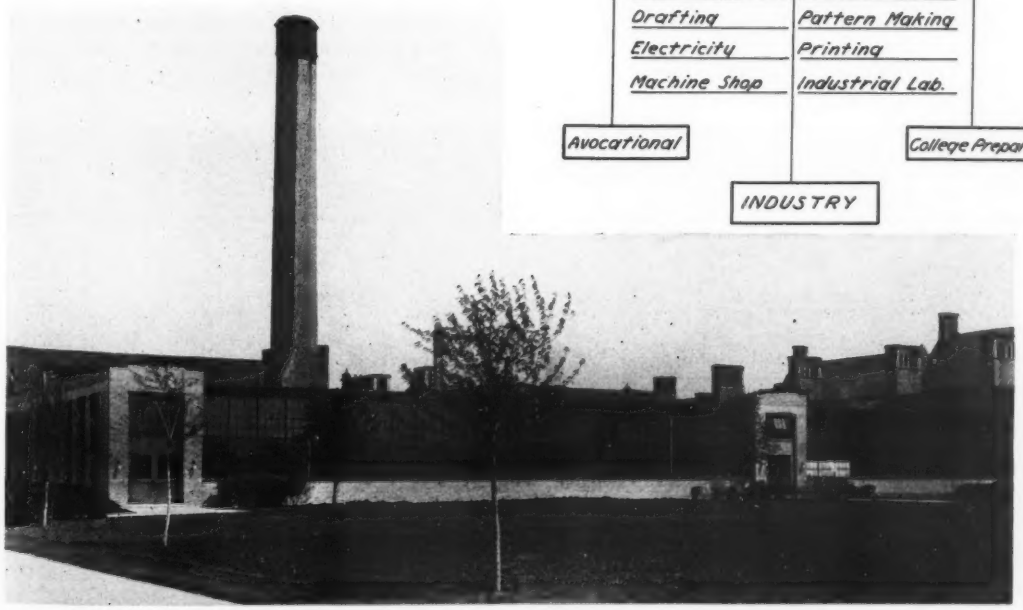
Second, that we are interested in all educational activities and in all students.

Third, that we feel it our duty to attack the problems of uniting the division of industrial arts, and that of vocational education into one unit and to so adjust this unit with all branches of education that both the school and the student may profit.

Finally, that technical training can and shall be offered in the regular curriculum of the junior- and senior-high-school courses of study in the same manner that English, mathematics, and other units of subject matter are offered.

As a means of administration in carrying out this plan, the industrial faculty has been divided into committees representative of the various course activities. The committees have





Fordson High School trade shops. 82 by 300 ft. 22-in. ceilings

Senior-high-school machine shop. This shop is 32 by 90 ft., and is equipped to accommodate 35 students

written platforms giving consideration to aims and objectives, information sheets, job sheets, assignment sheets, etc. This curriculum-building work has been done with the coöperation of the teacher-training institutions and the university.

The *elementary division* aims to introduce the boy of the sixth-grade level to general-shop work. Activities include projects made of tin, brass, leather, reed, etc. Such seasonable interests as kite flying, boat construction, birdhouse contests, Christmas toy repair, etc., are made possible.

The *junior-high-school* curriculum is formulated around the unit-shop type of education. There are five such units (electricity, woodwork, sheet metal, bench metal, and drawing) required in the seventh- and eighth-grade levels. Advanced work in the same units is offered in the ninth grade and in addition auto mechanics, machine shop, and printing are given. We include in this level of work our industrial preparatory (precontinuation, coöperative, and part-time school) course of study. Students in this division may elect any of these activities in accordance with ability and advisement.

The *senior-high-school* curriculum of industrial and vocational education is divided into technical training, college preparatory, full-time trade training (Smith-Hughes), part-time trade training, and coöperative education. Our senior-high-school shop teachers are all Smith-Hughes teachers with life certificates or degrees. Trade training is offered in the following subjects: Electricity, patternmaking, auto mechanics, machine shop, drafting, and printing. In addition, courses are offered in aëronautics, industrial laboratory (general metal), woodworking, related drawing, and bookbinding.

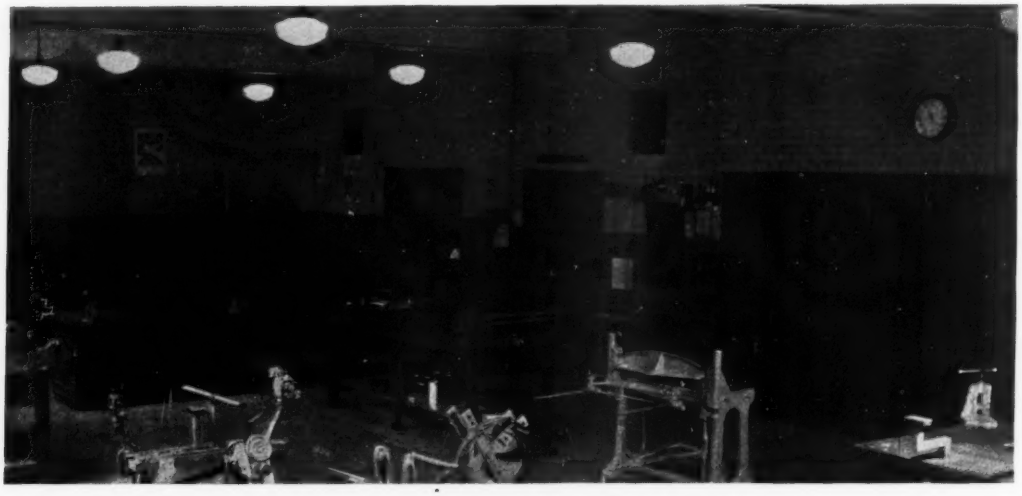
The building units are as follows: Elementary shops, 4; junior high schools, 3; and senior high schools, 1. These are exclusive of the Dearborn public schools.

Both the general and unit-shop type of junior-high-school organization are used. The senior-high-school division consists of technical and trade training, including Smith-Hughes classes.

Our industrial preparatory and continuation units are a division of our coöperative education plan and are housed in both the junior and senior high schools.

Industrial preparatory classification is made by age level (15–17) instead of grade level and is equivalent to elementary continuation school.

As a standard junior-high-school unit, the Harvey H. Lowrey School is representative. The unit consists of electric shop, woodworking (wood patternmaking included), general metal,



Lowrey Junior High School general metal shop

machine shop, auto mechanics, printing, and mechanical drawing (included in all levels).

The senior high school includes two courses of study: technical education which is industrial education and full-time trade training; and the other, part-time and coöperative.

Technical and trade units consist of drafting and related drawing, printing, electricity, auto mechanics, aëronautics, machine shop, wood and metal patternmaking, and technical courses of industrial laboratory.[1]

[1]Required as a related subject for all but printing students.

Problems and Projects

LATHE CABINET

E. Bereit, James Ford Rhodes High School, Cleveland, Ohio

To arrange the tools and equipment of a general metal shop presents a problem of some difficulty and very often taxes the ingenuity of the instructors. The old-fashioned toolroom has many things in its favor and all will agree that a well-arranged and easily checked toolroom does not need any apology. It is rather obvious, however, that machine equipment which is stored in and checked out of a toolroom, requires much useless movement on the part of pupils and instructors, complicates the problem of checking, and generally is rather unsatisfactory.

The cabinet which is here presented aims to do away with these difficulties, and to permit the student to use his machine time economically and efficiently. It may be set in any convenient position at the lathe; the writer has his at the foot, and has found it extremely helpful and useful.

The cabinet may be built of any suitable wood and may be finished in any scheme that will harmonize with the shop equipment. Every particle of space is utilized; the bottom or floor is not utilized because the tools and equipment are hung on brackets or pegs mounted on the inside back panel, both side panels, and the door panel. The latter is hinged in such a way that the small tools, which are stored on it, may hang outside in front of the cabinet and still have the other equipment locked inside. The cabinet may be constructed in any woodshop and the metal instructor can then make all brackets on which to mount his lathe tools and equipment.

The brackets, which have been made from 16-gauge steel, were designed to fit the tools and equipment for a 11-in. South Bend lathe. If any other lathe is used, it will be necessary to make the slots and holes to fit the equipment provided.

The pegs on the turning panel are to be made of 5/16-in. round steel and driven into holes drilled as indicated in the detailed drawing. All the faceplates, chucks, and steady rests should be hung on the pegs located on the back panel. The pegs should be turned to fit through the back of the chuck or faceplate.

The hinged panel is pivoted on ⅜-in. diameter steel rods which have been driven in from both ends. A plate of ¼ by 1-in. cold-rolled steel is fastened on the cross members as a bearing for the pins and as a thrust bearing to take the weight of the door and also insure smooth action. A washer on the bottom pin will eliminate any possibility of the panel sticking. On the inside of the door a butterfly cupboard latch is used on both sides to lock the panel in place.

The top of the cabinet may be covered with sheet metal to protect the finish and also lengthen the life of the cabinet.

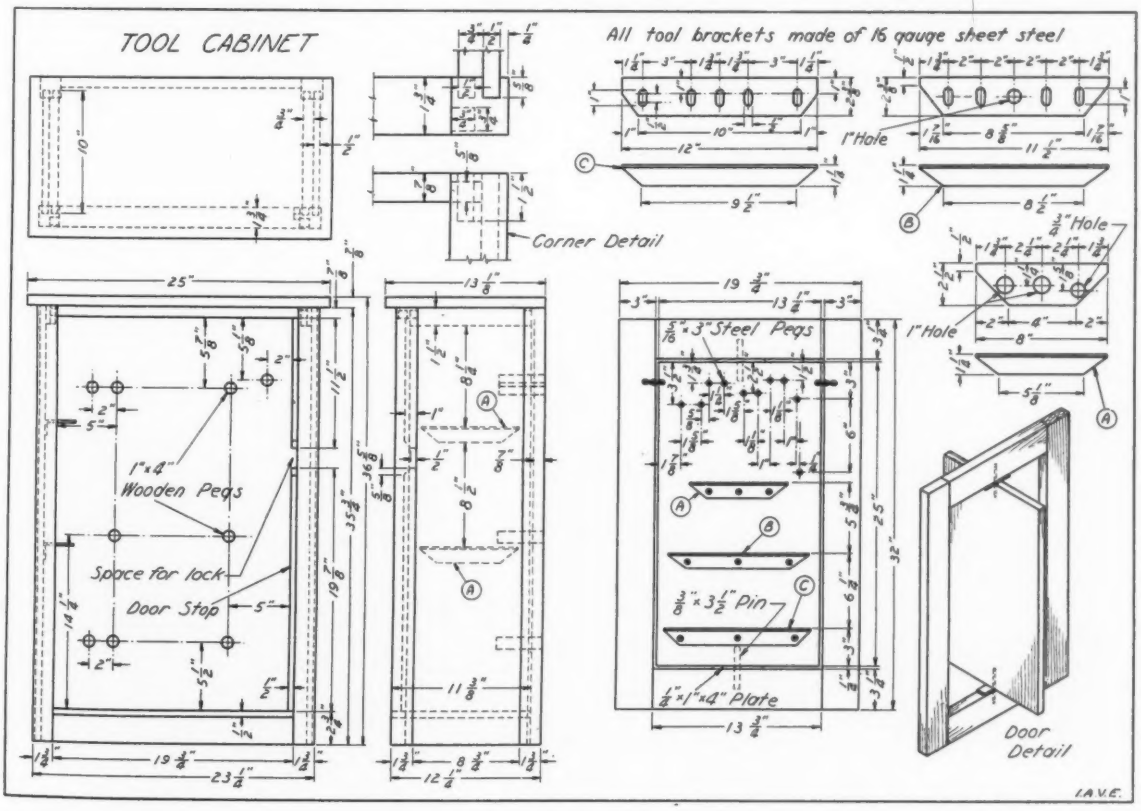


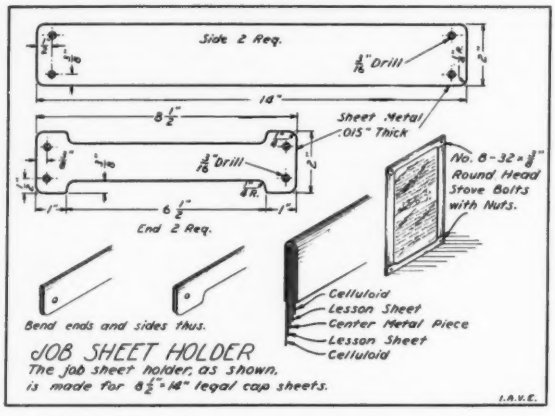
Fig. 1. The closed tool cabinet. — Fig. 2. An interior view. — Fig. 3. The door panel revolved, permitting access to the tools even though the door is locked

JOB-SHEET HOLDER

A. L. Dell, Grand Rapids, Michigan

The illustrated lesson-sheet holder is devised so as to have no lost *usable* space; is dirtproof and reasonably oilproof.

The holder consists of a moderately thick central sheet of metal faced on each side by cellophane or celluloid about .010 or .015 of an inch thick. This provides space for a mimeograph sheet on each side of the holder. The binding strips are made by folding sheet metal in channel form.



In assembling, slip the cellophane, mimeograph sheets, and thick sheet of metal into one of the channels. Slide on the other channels and clamp with machinist clamps. Drill 3/16-in. holes in the corners of the holders and fasten the parts together with the stove bolts.

A WORKBENCH CONVENIENCE

V. C. Darby, Cedar Rapids, Iowa

In the workshop, small drills, countersinks, nail sets, screw-driver bits, center punches, etc., can easily be lost in the shavings and swept up and destroyed if unusual care is not taken. To prevent this, it is well to keep a little wooden block, with a number of ⅜-in. holes drilled in it setting on the bench. It takes only a second to drop a small tool in one of the holes, and the time required to find the same tool again when wanted is about one tenth of what it is when such a device is not used.

It may be made of a piece of maple 1¾ by 3½ by 6½ in. Drill the holes 1⅜ in. deep, on 1-in. centers, with the center line of the first row ¾ in. from the edge. This will give 15 holes, with ample space between so that any tool may be withdrawn readily.

Paint the block some bright color, like red or orange. This helps to keep the device in sight and reduces the chance of its going astray, as the bright color shows up readily among shavings and workbench litter.

WALL TOOL CABINET

U. G. Whiffen, State College of Washington, Pullman, Washington

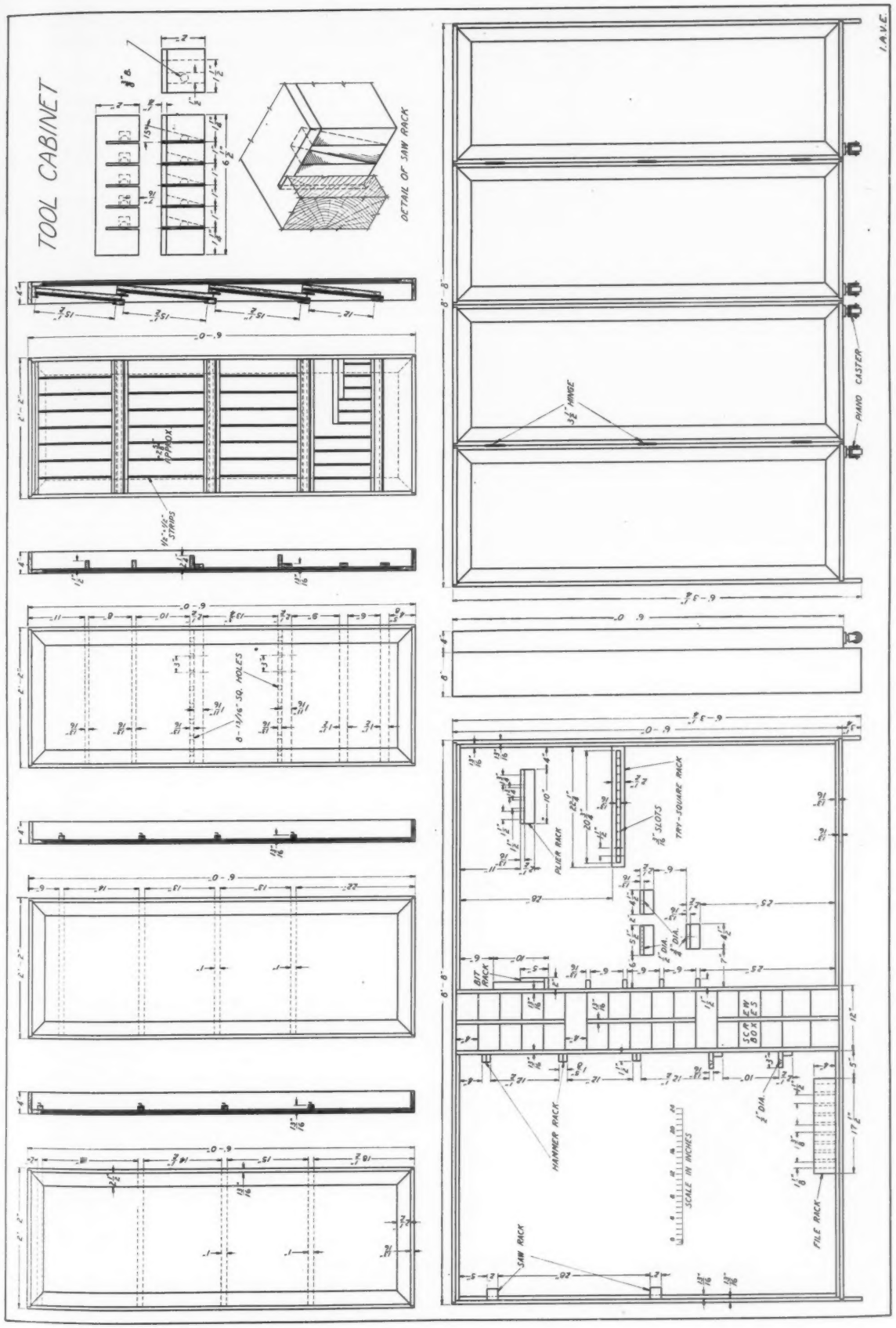
The tool cabinet illustrated and described herewith has proved very satisfactory in a shop which has only limited floor space. The condition of the tools is very easily ascertained, as all of them are in full view. The large back area and the space on the doors afford ample opportunity for accommodating many tools. The drawers in the center are convenient for brads, tacks, nails, or other small articles.

If the dimensions given in Figure 1 do not fit the space in which the cabinet is to be built, they may be altered to suit conditions.

The back of the cabinet is made of 13/16-in. material which is set into a ⅜ by ¾-in. rabbet plowed down the inside edge of the two side pieces. A rabbet is also plowed at the top and bottom of the side pieces into which the end pieces are fastened. The back is then nailed or screwed on. After the back is fastened the space for the drawers is laid off and uprights are plowed and fastened in place.

When making the doors the length of the back is divided into four equal parts to give outside dimensions for the doors. If the cabinet is made shorter than the one shown two doors may possibly suffice. The doors are made by using a half-lap butt joint on the outside pieces and a butt joint on the inside pieces with mitered corners, and a ⅜-in. rabbet plowed up the center to take the panel. The center pieces for the door are held in place with screws which have been countersunk and plugged.

The saw hanger is made by taking a piece of 2 by 2-in. hard wood and sawing a kerf 1½ in. deep along one side. The block is then turned over and a groove cut at an angle of about 15 deg. with the kerf. The groove should be large enough to take a ⅜-in. ball bearing. After the grooves have been made, the ball bearings are put in place and a piece of ¼-in.



Wall Tool Cabinet designed by U. G. Whiffen, Pullman, Washington

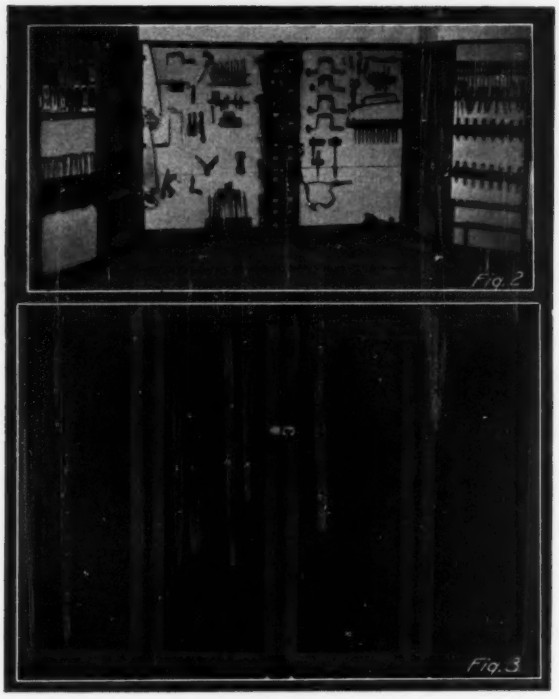
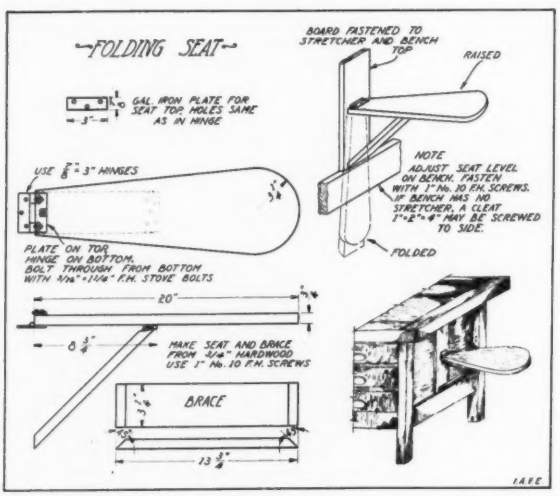


Fig. 2. The tool cabinet opened for use. — Fig. 3. An exterior view of the tool cabinet

material is tacked over the top to keep the balls in place. When fastening the hanger in place, the ¼-in. material should be on top. When a saw is put in the hanger, the friction on the saw against the ball pulls the ball down and wedges the saw in place and holds it very firmly.

The remainder of the tool hangers are shown in Figure 1. Any other methods of hanging that may be convenient may be used.

After the cabinet has been made, the backs of the doors and the back of the cabinet may be covered with wall board to give the cabinet a smooth surface. The outside may be finished to suit the trim of the room.

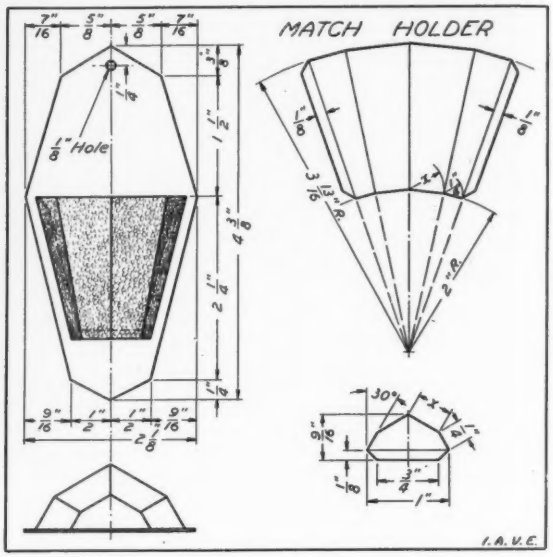

FOLDING SEAT
BOARD FASTENED TO STRETCHER AND BENCH TOP
RAISED
GAL. IRON PLATE FOR SEAT TOP, HOLES SAME AS IN HINGE
USE 7/8" - 3" HINGES
NOTE ADJUST SEAT LEVEL ON BENCH, FASTEN WITH 1" No. 10 F.H. SCREWS. IF BENCH HAS NO STRETCHER, A CLEAT 1"×2"×4" MAY BE SCREWED TO SIDE.
PLATE ON TOP, HINGE ON BOTTOM. BOLT THROUGH FROM BOTTOM WITH 5/16" - 1 1/4" F.H. STOVE BOLTS
FOLDED
20"
MAKE SEAT AND BRACE FROM 3/4" HARDWOOD USE 1" No. 10 F.H. SCREWS
BRACE
13 3/4"
I.A.V.E.

Folding seat for the general shop. Designed by Carleton E. Beck, Lockport, New York

SHEET-METAL MATCH HOLDER

Colin D. Robertson, Jamaica Continuation School, New York, N. Y.

In this era of budget slashing and economy which might impair the efficiency of our schools if we did not revise our projects to meet the new situation created by a desire of the public to curtail expenses, the accompanying illustration of a sheet-metal match holder shows a project which should prove popular.



Scrap tin plate, sheet brass, copper, or pewter may be used. A very attractive design is to make the back out of brass and the front and bottom insert out of copper, hammering the copper front lightly with a 6-oz. ball-peen hammer before bending to shape.

After the front is bent to shape, the bottom is soldered on inside. File the edges smooth and tin with soldering paste and soft solder. Place the front on the back and see that there is a perfect fit. Scratch the outline on the back and tin inside the outline about ⅛ in.

Now place the parts together, hold with a pair of pliers and sweat the joints using a hot soldering copper on the back immediately behind the joints. A bunsen flame may be used, but greater care will have to be taken not to overheat and melt out the bottom piece.

Polish with steel wool, then lacquer. The back may be enriched by chasing in some simple design.

A TOOL CABINET

Reuben Schmitt, Boude Storey School, Dallas, Texas

A tool cabinet, if it is to be efficient, must satisfy local requirements. The great variation in equipment lists among schools precludes duplication of cabinets. However, standards can be set up which will act as guides in building or selecting a cabinet. The following suggestions may well be considered:

I. *The cabinet must be economical of space.*
   A. The area of walls and doors must be used to best advantage.
   B. The volume of space within the cabinet must be used.

II. *The tools must be arranged efficiently.*
   A. Tools of frequent demand must be easily accessible.
   B. Withdrawal of any tool must not endanger neighboring tools.
   C. Tool checker must be able to grasp tools easily and securely.

(Continued from page 73)

Stanley Tools

Educational Department New Britain, Conn.

Manufacturers of

Hand Tools for

Woodworking and Farm Shops — The most complete line offered by one manufacturer. Ask for Catalogue No. 34A.

Electrical Shops—Hammers, Bit Braces, Bit Extensions, Screw Divers, etc., Ask for Catalogue No. 34A.

Sheet Metal Shops—Hammers, Chisels, Punches, etc. Ask for Catalogue No. 34A.

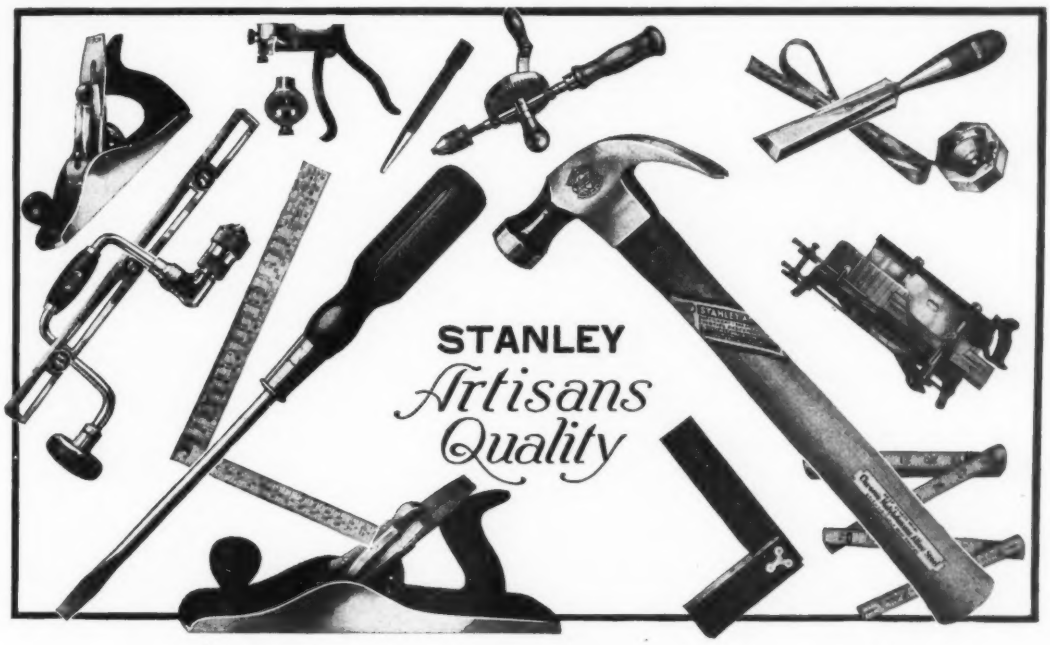
Automobile Shops—Body and Fender Tools, Hammers, Chisels, Punches, Pliers, Files, Screw Drivers, etc. Ask for Catalogue No. 26A.

Machine Shops— Hammers, Rules, Chisels, Punches, Levels, etc. Ask for Catalogue No. 34A.

Forge Shops — Anvil Tools, Tongs, Hammers, etc. Ask for Catalogue No. 34A.

Instructors of the shop subjects listed above should have our catalogue when specifying equipment. The catalogues are illustrated below—send for them.

The hard and accelerated usage that tools are subject to in the school shop demands quality tools. For more than three-quarters of a century Stanley Tools have been made to the sound policy of Quality First. Specify Stanley Tools for the utmost in economy and service and avoid substitutions.



Send for these Special School Catalogues

Catalogue No. 26A - Automotive Tools

Shows a complete line of hand tools, with the exception of wrenches, and a complete line of Body and Fender Repair Tools. It describes chrome vanadium alloy steel Chisels and Punches, molybdenum alloy steel Pliers, new Screw Drivers with Stanloid handles—the toughest non-metallic substance known — and many other tools of particular value to the school shop.

Catalogue No. 34A with School Index

Illustrates and describes over 1500 Stanley and Stanley-Atha Woodworking and Metal Working Tools — 215 pages. It is furnished with a special school index which lists the proper tool equipment for the Elementary, Junior High, Senior High and Vocational School Shops. You will find this book helpful in making up your tool specifications.

"Stanley Equipment is Standard Equipment"

Stanley Tools, Educational Dept. 106 Elm Street, New Britain, Conn.

Woodworking Equipment and Supplies

Teachers and supervisors may find these maximum lists helpful in checking their inventories or preparing their budgets.

Name and Description	No.
Benches	
Hardwood tops, 1¾ in. or over in thickness, built up of strips with tongue-and-groove joints, the top to project far enough to allow a rapid-acting or continuous screw vise to be attached. It is a good idea to order a 1-in. birch or maple board wide enough to cover the working face of the bench at the time of buying the benches. This board can then be fastened to the top proper with screws and may be conveniently replaced when worn. The benches should be made of thoroughly kiln-dried lumber throughout. They may be either plain or of 6-drawer type	
Glue	
Stain, with metal-covered top	
Teacher's Demonstration....	
Blackboard	
Permanent or portable	
Bookcase	
For reference books, catalogs, etc.	
Bulletin Board	
Cabinets, wood or metal for filing class records, instruction sheets, drawings, etc....	
Chairs	
Tablet-arm chairs	
Core Oven (for patternmaking class only)	
Desk	
Teacher's, with drawer compartments	
Chair, to match desk.....	
Furnace, for melting soft metals (for patternmaking class only)	
Glue Pot, 1-qt., or 2-qt. size, electric, gas, or steam heat..	
Glue Warmer or Cooker	
1 to 5 gal. capacity.....	
Grinder	
Automatic knife, direct motor-drive type. Size to suit largest knife used in the school shop. Grinder to be complete with water pump, grinding wheel, and automatic stops	
Bench, hand or power.....	
Bench, motor-in-head. Motor bearings to be completely housed. Wheels to be equipped with safety flanges and carefully guarded throughout. One fine-grit, and one coarse-grit wheel	
Revolving oilstone, pedestal type, with one fine and one coarse oilstone	
Jointer	
6- or 8-in. portable jointer. Table to be fitted for rabbeting. Safety-cylinder type, and equipped with safety guard	
12-, 16-, or 18-in. direct motor-drive, ball-bearing. Cylinder to be of safety-head type. Table to be fitted for rabbeting. Jointer to be equipped with safety guard	
Lantern	
Stereopticon-view machine for opaque objects and standard-type lantern slides	
Lathes	
6- to 16-in. motor-in-head, motor-in-base, or belt-driven speed lathe, to take 24, 36, 48, 60, or 72 in. between centers. Each to be complete with cup center, spur center, faceplate, rosette chuck, tool rests, and center drift for head block...	
Patternmakers, with end faceplate provision. Lathe to be of direct motor-drive type, equipped with variable-speed motor, faceplates and floor stand. (For patternmaking class only).	
Mortiser	
Direct motor, or belt driven, hollow-chisel mortiser, foot feed. Table to be of the tilting type with hold-down clamps and stop rod.....	
Portable, vertical, hollow-chisel mortiser, bench type	
Planer	
12-, 18-, 20-, 24-, or 30-in. motor or belt-driven, single-surface planer. Safety-head cylinder, three-knife type, fitted with good-grade steel knives. Knife setting and jointing device complete with bar should be mounted on machine if possible	
Saws	
Band Saw, 20- to 36-in. motor drive. Upper and lower wheels to be completely guarded. Table to tilt to 45 deg.	
Combination, band saw, crosscut saw, rip-saw, and mortiser. Machine to be completely guarded	
Cut-off, pedestal or swing type to be fitted with 12- to 16-in. saw	
Filing machine, direct motor-drive	
Jig, direct motor or belt-driven	
Portable band saw, 16 to 20-in. ball-bearing, motor driven	
Saw bench, direct connected to motor, and to have both rip and crosscut saws. Rip and crosscut gauges also to be provided	
Universal saw bench, 14 to 16-in., motor driven	
Variety saw bench, motor-driven, tilting table, with universal sliding table. The arbor is to be fitted for a dado head, and the table is to be slotted accordingly. The saw is to be equipped with ripping fence and miter cut-off gauges	
Sander	
Belt, direct motor-drive.....	
Disk, motor or belt driven...	
Oscillating-spindle, motor driven	
Portable, hand-plane type. Direct motor-drive	
Verticle-spindle and disk sander	
Shaper	
Motor-drive, single or double spindle. Table to be equipped with removable center plate.....	
Portable shaper or router with a suitable selection of cutters	
Tenoner	
Single end, with coping heads and cut-off saw	
Vises, rapid-acting or solid-nut type woodworking bench vises, 7 to 10-in. face.....	
Wood Trimmers, complete with all gauges and taper pins. Base of trimmer to be slotted and laid out for degree settings. (For patternmaking class only).....	

Woodworking—Small Tools

Name and Description	No.
Awls, Brad, assorted sizes.....	
Bevels	
Protractor	
Sliding T, 8"	
Bits	
Auger, 3/16" to 1" inclusive by 16ths, each	
Auger, 1/4" to 1/2" inclusive by 16ths, each	
Braces, ratchet type, 8", 10", 12" or 14" sweep.....	
Countersink, for wood, rose	

(Continued on page 70)

Huther Bros. Saw Mfg. Co.

1290 University Ave., Rochester, N. Y.

Manufacturers of

Circular Saws, Groovers, Band Saws

Huther Bros. Saws are the result of more than sixty years' successful and uninterrupted experience in the manufacturing of saws. Each saw embodies the highest type of workmanship and is backed by a guarantee to be as free from flaws and seams as possible. Complete catalog on request.

Dado Head

Our dado head developed from our own patents cuts grooves with or across grain, smooth, sharp sides, grooves from ⅛" up to 4" and over. Easily adjustable. Consists of 2 outside Cutters ⅛" thick and inside cutters to make desired cut. Inside cutters in 1/16", ⅛" and ¼" thicknesses. These Groovers make a perfect cut and leave the bottom smooth.

High Speed Knives

Shaper Stock, Ground Flat Stock

We manufacture thin High Speed Steel Knives, Solid Moulder Knives from High Speed Steel or Special Laid Steel. We can also furnish ground stock in various thicknesses and widths, square edges, in High Speed or best quality Tool Steel.

Inserted Tooth Groover

This is the perfect Groover for end grain cuts in hard wood. Teeth are High Speed Steel, front to back clearance, and require grinding on top only. Cuts full width groove through life of teeth. Teeth can be replaced.

Saw Vise

Setting Stake

These are useful articles for the filing room and were both developed for use in our own filing department. Vise is easily adjusted for various bevel filing and takes saws up to 18" diameter.

Angular Hub Groover

(New Patent No. 1782507)

This Groover was designed to cut end grooves in hard wood and to clear itself easily without swage or set. Clearance is effected by angular grinding of hub. Light adjustment. Used on regular saw mandrel without extra collars.

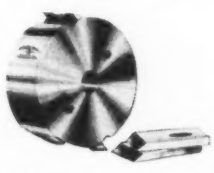
Band Saws

We make both wood and metal cutting band saws, also special temper saws for fibre, bakelite and soft metals. Let us know what you cut and we can furnish a saw for the purpose.

New Steady Rim Rip

This is an extra smooth cutting Rip Saw designed for smooth cutting at fast feed. This is the smoothest cutting Rip Saw we have and is capable of beautiful work.

Cutter Heads for Saw Mandrel



Cutter Heads for use on saw table. These heads can be furnished with variety of knives and used for jointing and running light moulding on saw table. Made in 6" diameter, 2¼" wide. Can be counterbored if necessary.

Mitre Saws

Our Mitre Saws are accurately ground with the proper side clearance and are made in six styles of tooth shape. Cleaner Tooth Saws are for both rip and cross-cut—made in diameters from 4" to 24".

(Continued from page 68)

Name and Description	No.	Name and Description	No.	Name and Description	No.
pattern, ½" and 5/8", each		**First-Aid Cabinet and Supplies**		Band, ¼", ½", ¾", to fit power machine, each	
Dowel, square shank, ¼", 5/16", 3/8", ½", ¾", each		**Floor Brushes**		Compass, 10"	
Expansive, 3/8" to 1½"		**Gauges**		Coping, frames	
Expansive, 3/8" to 3"		Bit, adjustable		Coping, blades	
Forstner, square shank, ¼" to ½" inclusive, by 16ths, each		Jointer		Crosscut, 9-tooth, 22" long	
Screw Driver, square shank, ¼", 5/16", 3/8", each		Marking, metal or hardwood		Crosscut, circular for power machine	
Twist Drill for wood, square shank, 1/16" to 3/8" inclusive by 16ths, each		Mortise, metal or hardwood		Dado, 1/8" to 1 1/16" to fit power-saw arbor	
Twist Drill, straight shank, 1/16" to 3/8", inclusive by 32nds, each		Panel		Hack, frames, 8" or adjustable	
Blow Torch		**Glass Cutter**		Hack, blades, 8"	
Brooms		**Gouges**		Keyhole, 10", 10 point	
Brushes		Tanged firmer, outside ground, handled, 1/8", ¼", ½", ¾", 1", each		Rip, 7 point, 22" long	
Bench Duster, 10"		Tanged-firmer, inside ground, handled, 1/8", ¼", ½", ¾", 1", each		Rip, circular for power machine	
Glue, round, ½" and ¾", each		Spoon, ½", ¾", and 1", each		Set, 10 points per inch and finer	
Glue, round, 1½"		**Hammers**		Set, 10 points per inch and coarser	
Marking, camel's hair, No. 1 and No. 2, each		Claw, bell-faced, 10 oz		Turning frame, 14"	
Varnish, flowing, 2"		Claw, bell-faced, 12 oz		Turning blades, 1/4"x12", 10 tooth	
Varnish, flowing, 2½"		Claw, bell-faced, 13 oz		Miter-box, 24"x4" saw, 7" capacity at miter	
Varnish, flat, ½"		Claw, bell-faced, 16 oz		**Scrapers**	
Varnish, flat, ¾"		**Hand Screws**		Cabinet	
Varnish, flat, 1"		Adjustable, length of jaws, 4", 5", and 6", each		Glue, triangular	
Burnishers, oval or round		Adjustable, length of jaws, 7", and 8", each		Veneer, blade 2¾" long, handle 11" long	
Calipers		Adjustable, length of jaws, 10", 12", and 14", each		**Screw Drivers**	
6", outside		**Hatchet,** Bench, 4" cut		Cabinetmakers', 4", 6", and 8" each	
6", inside		**Jars,** Earthenware, 1-qt. capacity		Quick-return, spiral ratchet	
12", outside		**Knives**		**Shoot Board,** and plane	
12", inside		Jointer, to fit power machine		**Snips,** Tinners', forged steel, 2½" cut	
Can Opener		Planer, to fit power machine		**Spokeshaves,** adjustable, raised handle, 10" long	
Carving Tools		Sloyd, 3" blade		**Squares**	
Sets containing 6 tools		**Levels**		Combination, 12"	
Sets containing 12 tools		Wood, 24"		Try-, iron handle, 8"	
Chisels		Machinists', 12"		Framing, 2'	
Cold, machinists', 3/8" and ½", each		**Mallets,** Hickory, 3" by 5" head		**Steel Figures,** hand cut, 1/8", sets	
Mortising Chisel and Bits, ¼" to 5/8" by 16ths, each		**Nail Sets,** Point, 1/16" and 1/32", each		**Tapeline,** 50' steel	
Socket-firmer, bevel edge, 1/8", 1", and 1¼", each		**Oilers,** Bench, 1/3 pt. coppered, best grade		**Trammel Points,** Adjustable metal frame, steel points	
Socket-firmer, bevel edge, ¼", ½", and ¾", each		**Oilstones**		**Turning Tools** (For 12 lathes)	
Socket-firmer, plain edge, ½", ¾", and 1", each		1"x2"x8" in iron box		Calipers, 6" inside and outside, 12 each	
Tanged-firmer, bevel edge, 1/8", ¼", ½", ¾", 1", and 1¼", each		Gouge Slip, medium, 4½"x2 1/16"x 5/16"x 1/16"		Calipers, 12" inside and outside, 1 each	
Clamps		Gouge Slip, fine, 3"x2"x 3/16"x 1/16"		Parting Tools, 1/8"	
Screw, adjustable, 24", 36", and 48", each		**Pincers,** 6" carpenters'		Round point, ¼", ½", ¾", each	
Screw, adjustable, 60"		**Planes**		Spear point, ¼", ½", ¾", each	
Tilting Saw		Block, adjustable, 6" long, 1 5/16" cutter		Square point, ¼", ½", ¾", each	
Dividers, Wing, 6" and 10", each		Circular		Turning Chisels, ¼", ½", ¾", each	
Doweling Jigs, with bushings		Combination, adjustable		Turning Gouges, ¼", ½", ¾", each	
Dowel Plate, 6" long		Core Box		Turning Skews, L.H. ¼", ½", ¾", each	
Drawknives, 7"		Duplex, fillister and rabbet		Turning Skews, R.H. ¼", ½", each	
Drill		Fore, 18", 2 3/16" cutter		**Vise,** 3" jaw, anvil face	
Automatic Hand, with 8 drill points		Irons, double		**Wrenches**	
Chuck, 0 to 3/8"		Jack, 14", 2" cutter		Adjustable, 8", 10", and 12", each	
Hand, 0 to 3/8", for round-shank drills		Jointer, 24"		Headless Setscrew, ¼" to 5/8" by 16ths, 1 each	
Star, for concrete, ½" and ¾", each		Round, wood, 1¾"		Pipe, 10" and 12", each	
Files		Router		S-type or open-end type to fit 1/8" to 1" U.S.S. nuts, each	
Auger Bit, assorted 6"		Smooth, 9", 1¾", or 2" cutter			
Cabinet, 8" and 10", each		**Pinch Dogs,** ¾", 1", and 1¾" each			
Card and Brush		**Pliers**			
Flat, wood 10"		Round-nose, 5"			
Mill, bastard cut, 10"		Side-cutting, 6"			
Round, bastard cut, 12"		**Putty Knives**			
Taper, slim, 5½" and 7", each		**Rasps,** half-round, wood, 10"			
		Rules			
		Board			
		1' or 2' graduated by 8ths and 16ths			
		Shrink, 1/8", 1/16", each			
		Saws			
		Back, 12", 14 point			

(Continued on page 72)

Porter - Cable Machine Company

PORTER–CABLE SANDERS

1919 Park Street, Syracuse, N. Y.

Representatives in Principal Cities

NRA

Manufacturers of **MACHINE TOOLS, SANDERS, GRINDERS, SAWS**

Practical tools for schools must be able to pay for themselves on maintenance and construction work as well as be available for vocational training work. Students should be trained to use the tools in school that they will use after they have graduated. Follow these specifications and your choice narrows to PORTER-CABLE EQUIPMENT

CONSIDERED from any angle PORTER-CABLE is the choice: *Maintenance Man*—He is interested in keeping desks, chairs, blackboards, floors, etc., in A-1 condition. He knows that his TAKE-ABOUT HAND SANDERS and SPEEDMATIC FLOOR SANDERS will do it. He knows that his TAKE-ABOUT will quickly pay for itself and the vocational training classes may have the advantage of its use in spite of restricted budgets.

Vocational Training Student—You can't fool him—He can't see any use in tedious hand sanding, for instance, when he knows he can do a better job much more quickly with a TAKE-ABOUT SANDER.

Vocational Training Teacher—He has a right to practical equipment that his time and his talents may not be wasted.

The School Board and The Taxpayers — Both of these groups are interested in lowering school taxes and both are interested in the best possible instruction for the students.

PORTER-CABLE EQUIPMENT SOLVES THE PROBLEM

SPEEDMATIC FLOOR SURFACERS 4 MODELS:

Keep school floors from showing the wear and tear of thousands of feet. School floors and stairs are subjected to continual wear during the school period. It is almost impossible to preserve their appearance without a SPEEDMATIC FLOOR SANDER. The SPEEDMATIC quickly restores floors to their original appearance. It is light, easily handled, and operates from light circuit.

DISC SANDER—3 TYPES

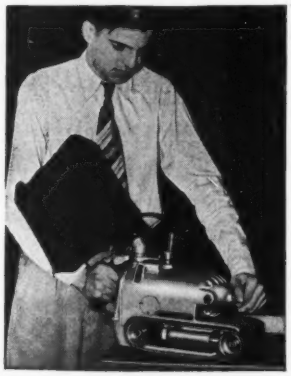
This machine, the pioneer of all dustless, motor - driven Disc Sanders, has proven by its years of universal service that it is the standard for performance and dependability. Built for accurate sanding of segments, angles for built-up work, core prints and circular taper work. Also useful for light grinding of metal and composite material. Runs off light circuit. Equipped with casters for portability. Ideal for instruction work.

BENCH AND PEDESTAL SPINDLE SANDERS

OSCILLATING SPINDLE SANDER is inexpensive, yet will answer all of your requirements for finishing curves and irregular work. Saves hours of hand sanding and chiseling. Oscillating motion defaces all sand marks and uses every bit of paper. Table Tilts 45° securing accurate drafts and angles. Pedestal model has casters. Plug into regular light circuit.

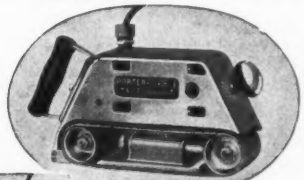
BELT SANDERS— 3 TYPES

BELT SANDER - GRINDER solves many surfacing problems. Vaccum dust collecting system. Very popular with vocational training instructors because of the large variety of surfacing possible. Long or short pieces, sanding down joints, making core prints are all within its scope. Perfectly safe and an excellent sander or all - around shop use.



Use The Dustless Type TAKE - ABOUT SANDER for maintenance work on account of greater power. Vacuum system practically eliminates dust. Like the other 4 TAKE-ABOUT models it saves hand sanding and scraping and when not in use in shop it pays for itself finishing desks, seats, tables, blackboards, etc.
This boy will have a practical knowledge o shop work and will be ready for production work when he graduates.

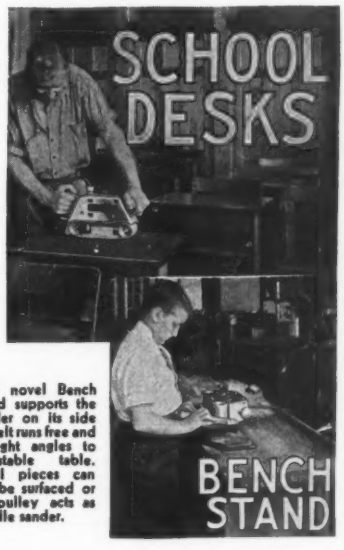
TAKE-ABOUT Sanders



Perfect Balance

Here is the NEW MODEL T-3 TAKE - ABOUT SANDER. First announced in August 1933 it has met with instant acclaim both in schools and industry. Its success due to recognized value of other 4 models of TAKE-ABOUTS. The T-3's light weight and Perfect Balance make it the pride of every student as an excellent finish is assured.

Other Porter-Cable School Equipment 14", 16" and 20" Band Saws, Speedmatic Saws, Ever-Ready Combination Woodworkers, also Jointers, Shapers and Disc Sanders. All equipment fully guaranteed and built to withstand both shop and maintenance work.



A novel Bench Stand supports the Sander on its side so belt runs free and at right angles to adjustable table. Small pieces can thus be surfaced or flat pulley acts as spindle sander.

Write for illustrated bulletins on any of this Equipment or a No-Obligation Demonstration.

(Continued from page 70)

Woodworking—Materials and Supplies

Name and Description	No.
Alcohol, gallons	
Benzine, gallons	
Brads, pounds	
3/8" No. 20	
1/2" No. 20	
5/8" No. 20	
3/4" No. 19	
7/8" No. 19	
1" No. 18	
1 1/4" No. 16	
1 1/2" No. 16	
1 3/4" No. 15	
2" No. 14	
2 1/2" No. 14	
Carbon Paper, black, sheets	
Colors, dry, 1-pound cans	
Burnt sienna	
Burnt umber	
Cobalt blue	
Chrome yellow	
Drop black	
Lamp black	
Prussian blue	
Raw umber	
Van Dyke brown	
Vermilion	
Colors, Ground, in oil or japan, 1-pound cans	
Burnt sienna	
Burnt umber	
Cobalt blue	
Chrome yellow	
Drop black	
Drop black, ground in japan	
Lamp black	
Prussian blue	
Raw umber	
Rose lake	
Van Dyke brown	
Vermilion	
Decalcomania Transfers	
Dowels	
1/4" hardwood, 3-ft. lengths, feet	
5/16" hardwood, 3-ft. lengths, feet	
3/8" hardwood, 3-ft. lengths, feet	
1/2" hardwood, 3-ft. lengths, feet	
3/4" hardwood, 3-ft. lengths, feet	
Dowel Pins and Plates	
Enamel	
White, 1-pt. cans	
Undercoater, 1-pt. cans	
Fillers, Paste, pounds	
Natural	
Golden Oak	
Dark Oak	
Mahogany	
Fillets, leather, 1/4" and 1/2"	
Glue, hide, best grade cabinet, pounds	
Liquid, 1-qt. cans	
Hardware	
Such as brackets, buttons, butts, casters, catches, chain, chest corners, chest trimmings, corner braces, corner irons, corner plates, desk fittings, door fittings, escutcheons, fasteners, handles, hangers, hinges, hasps, holders, hooks, knobs, latches, lamp fittings, lid supports, locks, pulls, smoking-stand outfits, springs, stops, supports.	
Hooks	
And Eyes	
Cup	
Screw	
Square Screw	
Lacquer, in 1-pt. cans	
Black	
Clear	
Cobalt blue	
Ivory	
Medium green	
Red	
Thinner	
White	
Yellow	
Lumber	
The following woods are used in school shops: Ash; balsa; bass; birch; cherry; cypress; locust; mahogany; maple; oak; poplar; red cedar; red gum; redwood; sap gum; yellow pine; walnut; white pine.	
In ordering pine, mill-run, kiln-dried will be found suitable for carpentry, while short select, kiln-dried 4" and wider, or No. 1 shop common, kiln-dried will be required for cabinetmaking and patternmaking.	
Hard wood, for furniture, should be specified first and second grade, kiln-dried, standard widths and lengths, or short lengths.	
Moldings	
Nails, pounds	
Common, 6d	
Common, 8d	
Common, 10d	
Flat Head	
1/2" No. 20	
3/4" No. 19	
1" No. 18	
1 1/4" No. 16	
1 1/2" No. 16	
2" No. 14	
Finishing, 4d	
Finishing, 6d	
Finishing, 8d	
Oil, gallons	
Linseed, boiled	
Linseed, raw	
Machine	
Rubbing	
Overlay Carvings	
Panel or Plywood	
3 ply, 5 ply, 7 ply	
Pattern Letters	
Pins, Escutcheon	
Pumice Stone, No. 0	
Rapping Plates	
Rottenstone	
Sandpaper, reams	
Garnet, No. 1	
Garnet, No. 1/2	
Garnet, No. 0	
Garnet, No. 2/0	
Garnet, No. 3/0	
Garnet, No. 4/0	
Garnet, No. 6/0, wet or dry finishing	
Garnet paper can also be obtained in rolls of 50 yd. each, and in widths 3" and up.	
Screw Eyes	
Screw Hooks	
Screws, gross	
Flat-Head, brass	
3/8" No. 3	
1/2" No. 4	
5/8" No. 5	
3/4" No. 5	
3/4" No. 6	
1" No. 8	
1 1/4" No. 10	
1 1/4" No. 12	
1 1/2" No. 10	
1 3/4" No. 12	
2" No. 10	
Flat-Head, bright	
1/2" No. 3	
1/2" No. 4	
3/4" No. 6	
1" No. 8	
1" No. 10	
1 1/4" No. 10	
1 1/4" No. 8	
1 1/4" No. 14	
1 1/2" No. 10	
1 1/2" No. 12	
1 3/4" No. 10	
1 3/4" No. 12	
2" No. 10	
2" No. 12	
2" No. 14	
2 1/4" No. 12	
2 1/4" No. 14	
2 1/2" No. 14	
Oval-Head, brass	
3/4" No. 5	
1 1/4" No. 10	
Round-Head, blued	
3/8" No. 3	
1/2" No. 3	
3/4" No. 5	
3/4" No. 6	
1" No. 8	
1 1/4" No. 10	
1 1/2" No. 10	
1 1/2" No. 12	
Round-Head, brass	
3/8" No. 2	
3/8" No. 3	
1/2" No. 4	
5/8" No. 3	
3/4" No. 5	
Shellac	
Orange, cut 4 pounds to the gallon, 1/2-gal. cans	
Sticks, assorted colors	
White, cut 4 pounds to the gallon, 1/2-gal. cans	
Note: Shellac should be kept in glass or earthenware containers.	
Stains, Oil, spirit or water, quarts.	
Fumed Oak	
Dark Oak	
Golden Oak	
Light Oak	
Mahogany	
Walnut	
Steel Wool, 1-lb. packages	
No. 0	
No. 00	
Turpentine, gallons	
Twine, balls	
Varnish, 1/2-gal. cans	
Flat	
Remover	
Rubbing	
Waste, pounds	
Cotton, white	
Wax, pounds	
Bees	
Finishing	
White Lead, pounds	

NEW BRITAIN STEEL EQUIPMENT FOR SCHOOL SHOPS

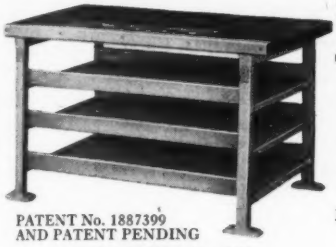
PATENT No. 1887399
AND PATENT PENDING
DRAWING TABLE No. 9655

"New Britain" Drawing Tables are available in more than 50 sizes and arrangements; with adjustable or stationary tops, with or without individual lockers, general drawers, or board compartments. *All steel* construction from floor to the wood top.

Manual Training equipment for your school shops must be of steel, to meet modern demands for *safe, sanitary and fireproof* working implements.

PATENT No. 1887399
AND PATENT PENDING No. 94212
NEW BRITAIN MANUAL TRAINING BENCH

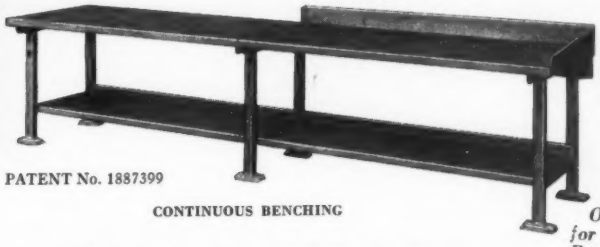
The "New Britain" No. 94212 Manual Training Bench shown here, is only one of more than 75 different sizes and combinations. Note its very evident strength and pleasing appearance. Everything on this bench is of *steel* except the laminated Maple Top.



PATENT No. 1887399
AND PATENT PENDING
STAKE BENCH No. 9600

30" x 6' x 32" high
Standard Lengths—6', 9', 21'
Standard Widths—30", 36", 42'
Standard Height—32"

Maple Top 2¼" thick, "New Britain" Stake Plates, angle iron edges rabbetted flush with top and edge; Type O Tubular Steel Sanitary Bench Legs, and steel shelves, edges turned up.



PATENT No. 1887399

CONTINUOUS BENCHING

WORK BENCHES

There is a New Britain Work Bench for every school shop need. All Steel construction throughout, except that, top may be of laminated maple, all steel, or a combination of steel with maple front vise plank. Furnished in a wide variety of styles and sizes in *single units* or as *continuous benching*, in multiples of any given single unit lengths with or without shelves, backs, end plates or drawers.

Other "New Britain" items for school shops include Stain Benches, Cabinet Benches, Art and Drawing Tables, Sheet Metal Work Benches, Battery Benches, Steel Stools, Steel Drawers, Steel Boxes. Send for our catalog No. 707SE.

The New Britain Machine Company
"Shop Furniture Originators" New Britain, Conn. U.S.A.
MANUAL TRAINING, VOCATIONAL, AND TRADE SCHOOL EQUIPMENT

(Continued from page 66)

D. It must be possible to return tools quickly and accurately to their places.

III. *The cabinet must be safe.*

A. Sharp edge tools must be placed in least dangerous positions.

B. Fragile and easily broken tools must be placed so that other tools cannot fall on them.

C. Tools must rest securely when they are returned to their places.

IV. *The cabinet must be easy and simple to check.*

A. Missing tools should make their absence known automatically.

V. *Expansion of equipment.*

A. Provision should be made for future additions of equipment.

VI. *Accessibility to teacher and students.*

A. Student tool checkers should be able to care for the cabinet with ease and accuracy.

The tool cabinet serving the woodshop of Boude Storey School, Dallas, Texas, was designed and built with the foregoing factors in mind. The inside dimensions of the cabinet are 15 by 64 by 75 in., thus affording ample space for over 300 tools and items of equipment.

The problem of economy of space was given major consideration. The wall space required for each group of tools was reduced to a minimum. Note, for example, in Figure 1, that the try-squares are mounted on a rack which permits them to be withdrawn and replaced from the front; they are not dropped into place from above, thus conserving the space above them. Furthermore, they can be withdrawn singly or in groups of two to six. The same commendable features characterize the support for the backsaws. The screw drivers, marking gauges, drill bits, and countersinks are mounted in a fixture which permits them to be withdrawn and replaced with maximum ease, in addition to keeping the space required for the tools at a minimum.

The volume of space within the cabinet is utilized to advantage. The handsaws, backsaws, coping saws, try-squares, hammers, and bit braces occupy a goodly share of the space, and yet the least possible wall area has been assigned to these

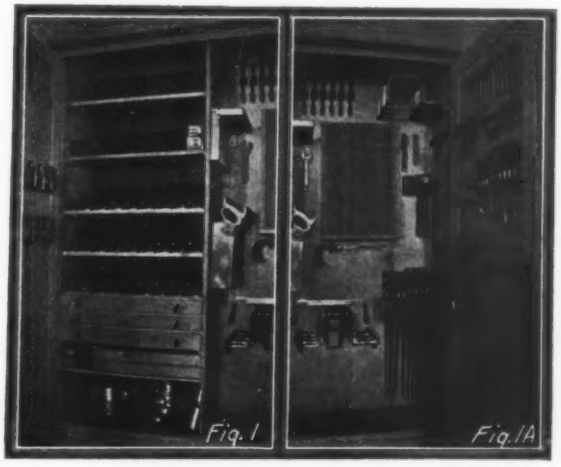


Fig. 1. Left-hand side of tool cabinet. — Fig. 1A. Right-hand side of tool cabinet

tools. Figure 2 illustrates the fixture for supporting the handsaws.

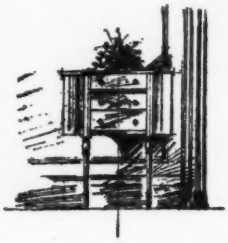
The tools are arranged in a reasonably efficient manner. Those of frequent demand are easily accessible; note the relative positions of the jack planes, try-squares, backsaws, screw drivers, bit braces, rules, and wood files. Furthermore,

(Continued on page 74)

KLISE

WOODCARVINGS—MOULDINGS ORNAMENTATION

THE ordinary every-day project of the vocational shop may be lifted out of the ordinary by treating it as the finer pieces of furniture are treated in the shops of the best furniture makers. It can be made an achievement in fine cabinet making through the application of carved wood mouldings.



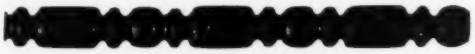
After careful coöperation with educational leaders and with some of the greatest furniture designers, Klise Manufacturing Company makes available to the Vocational Shops the materials with which to build these more beautiful pieces.

"BOOK OF PROJECTS"

The "Book of Projects" introduces to you not only many fine new projects, but also carved wood mouldings, ropes, beads, rosettes, etc., and shows you the application of these carvings in the enrichment of your projects. A charge of 50 cents per copy is made for the book. Complimentary copies to supervisors only.

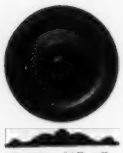
Klise Products

A few typical examples of mouldings and ornamentation are illustrated below. There are many other designs available at exceedingly reasonable prices, and we will welcome correspondence in regard to the carved wood decorations of projects.



G-51—Sizes ⅜" and ½" Dia.

D-774 — ⅜" x ⅜"



R-810—¾", 1", 1¼", 1½"
Gum-Wal.-Mhgy.

Plain turned rosettes are available in a variety of design, size and wood.

R-840—1½" Dia.

Many patterns of carved rosettes in unusual designs are supplied in a good range of size and wood.

A-6
½" Dia.

ROPE MOULDINGS

Rope mouldings are a popular type of ornament. A carefully selected group of patterns are offered for your selection. Ropes together with beads are stocked in several woods, numerous sizes and in full round and half round shapes.

Small Sample Assortment for School Shop Use Upon Request

KLISE MANUFACTURING CO., Inc.
Grand Rapids Michigan

(Continued on page 73)

the withdrawal of any tool does not endanger neighboring tools. The tools are arranged so that the tool checker can grasp them easily and securely; note, in this connection, the positions of the jack planes, hammers, bit braces, screw drivers, and backsaws. In addition to their being easily withdrawn, the tools can also be returned to their places with speed and accuracy.

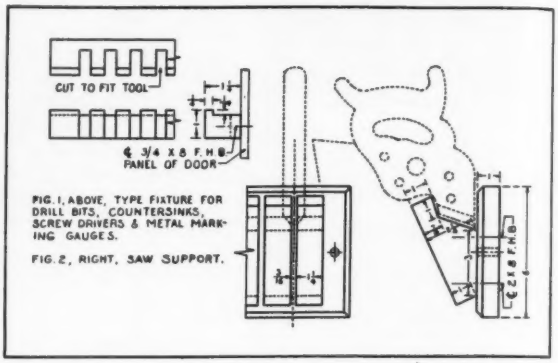

CUT TO FIT TOOL
¢ 3/4 X 8 F.H.B.
PANEL OF DOOR
FIG. 1, ABOVE, TYPE FIXTURE FOR DRILL BITS, COUNTERSINKS, SCREW DRIVERS & METAL MARKING GAUGES.
FIG. 2, RIGHT, SAW SUPPORT.

Fig. 2. Tool supports

The cabinet is safe in addition to being economical. Sharp edge tools are placed in the least dangerous positions. The chisels are kept in the top drawer, and the turning tools are kept in trays. By careful planning, fragile and easily broken tools are placed out of danger of accidentally falling tools; for example, the bit braces, squares, and planes are out of danger of a falling hammer. When the tools are returned to their places, they rest securely in their places.

In spite of the fact that the cabinet herein described, contains over 300 tools, its contents can be checked accurately in fifteen seconds.

The cabinet was designed with a thought to the future. Considerable space was allowed for additions of equipment. Furthermore, all jigs and fixtures are mounted with screws or bolts, thereby permitting rearrangement.

Students can care for the cabinet with ease and safety. It was designed with the student tool checker constantly in mind.

MIXING COLORS

Gerald A. Boate, Seattle, Washington

The inconvenience and delay caused by not having the colors desired to touch up a job, may be avoided if a few colors are always kept on hand which, if blended, will produce almost any shade desired.

For this purpose, just five cans of paint are needed: blue, yellow, red, black, and white. The directions which follow show how these colors may be blended to produce desirable shades:

Orange: Red when mixed with yellow produces orange. The shade of orange is governed by the quantity of red used, therefore the red should be poured into the yellow a little at a time while stirring vigorously until the desired shade has been obtained.

Purple: Red and blue when mixed will produce purple. The depth of the purple is governed by the amount of red used.

Green: Yellow when mixed with blue produces green, the depth of the color depending upon the proportions of the two.

Brown: When small quantities of red and black are stirred into yellow, brown will be produced.

Pink: Red and white, when mixed, produces pink. The warmth or depth of the shade is governed by the amount of red.

(Continued on page 76)

The need for Economy may cause endless worries to those contemplating the Purchase of School Shop Equipment. Discriminating and Wise buyers eliminate worries by buying Delta Machines.

The responsibility of stretching the school shop dollar on the purchase of new equipment for school shops is one that many schoolmen are facing today under the Emergency Reconstruction Act. Classes are large so the temptation is present to buy as cheaply as possible in order to get quantity, or to buy only a few units at high cost.

Some of the projects completed with the aid of Delta Woodworking Machines. These show the adaptability and range of project work possible.

Delta Mfg. Company
Dept. E-234, 3775 N. Holton St.
Milwaukee, Wisconsin.

I want a copy of the new 1934 Catalog K-1.

Name .....

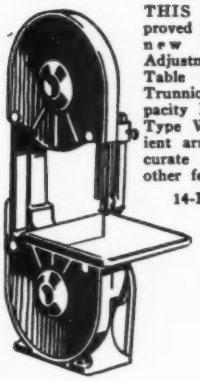
School ..... Position .....

Address .....

City ..... State .....

Well informed school shop men, however, turn to Delta machines. They know that these tools are big enough for all purposes, more than durable and strong enough, very attractive in appearance and of a cost surprisingly low for the quality delivered. They know that community approval immediately follows because of its previous acceptance and experience with these same machines.

NEW 14-INCH BAND SAW



THIS is the first really improved Band Saw in years! Has new Independent Micrometer Adjustments for guides. Tilting Table on ingenious Double Trunnion Supports, Variable Capacity Frame, New Safety Disc Type Wheels, new and convenient arrangement for quick, accurate adjustment and many other features.

14-INCH BAND SAW

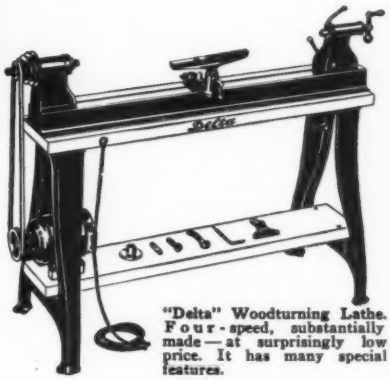
No. 890 **$43.85**

NEW DELTA DRILL PRESS

A floor-type drill press at the price of of a bench model; a real production-shop machine. Very heavy cast-iron head, self-sealed ball-bearing spindle of free-floating design. Interchangeable spindles available for routing, shaping, etc. Quick-set adjustable pointer and graduated quill for depth drilling. Standard spindle fitted with "Delta-Grip" chuck; Jacob's chuck also available. Head reversible for shaping work if desired. Does drilling, boring, mortising, routing, carving, sanding, shaping. Full line of shaper accessories are available.

No. 970 — "Delta" "Triple-Duty" Drill Press, with belt and motor pulley, but without motor.

$32.85



"Delta" Woodturning Lathe. Four-speed, substantially made — at surprisingly low price. It has many special features.

NEW DELTA 4-SPEED LATHE

Finest lathe ever made for small workshops. Timken-bearing head-stock with built-in indexing mechanism. Very heavy steel bed. Graduated tailstock sleeve and adjustable pointer for depth drilling. Quick-acting tailstock clamp. Many other advantages.

No. 930 Delta "Double-Duty" 11-inch 4-speed Lathe, with 3 in. faceplate, Allen wrench, faceplate wrench, taper shank, spur and cup centers, tool support wrench. 4" and 12" tool supports and tool-support base **$28.85**

Less stand, motor and belt.

USE COUPON FOR MORE DETAILED INFORMATION

DELTA MANUFACTURING CO.

DEPT. E234-3775 N. HOLTON ST., MILWAUKEE, WIS.

FOR VISES-SPECIFY "MORGAN"

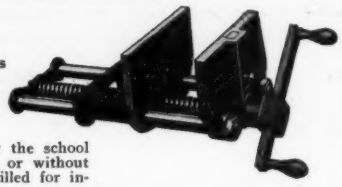
YOU ARE MONEY AHEAD IF YOU DO

They don't cost any more and are unsurpassed for strength, rigidity and durability. They are guaranteed against breakage. Any part broken in service is replaced free of charge. When through wear it becomes necessary to replace parts, this is easily accomplished because special machining allows interchangeability of all parts.

Continuous Screw Parallel Bar Vise

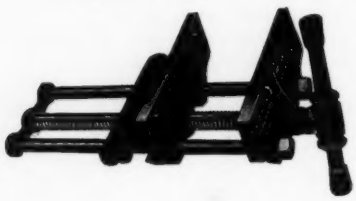
Adjustable Steel Handle—Stop in Front Jaw
Wood Handle Furnished If Desired

Vise No.	Width of Jaw, Inches
210A	7
215A	8
220A	10



Our most popular series for the school wood shop. Furnished with or without stop in front jaw. Faces drilled for installation of wood faces.

Quick Action Vise (Toles Pattern)

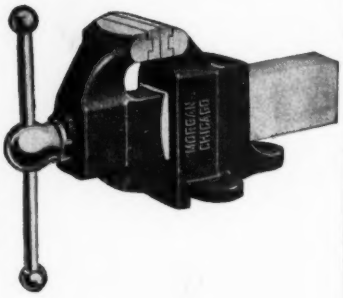


Vise No.	Width of Jaw, Inches
100	7
200	10

Has unusually effective and durable working action. Screw is 1¼" in diameter. Half nut of high quality bronze with accurately cut threads. Furnished with or without dogs in front jaw.

Stationary Base Machinists' Vise

Vise No.	Width of Jaws, Inches
30	3
35	3½
40	4
45	4½
50	5



Is unsurpassed for strength and durability. A larger portion of the sliding bar is solid instead of being cored all the way through as in other vises.

Swivel Base Machinists' Vise

Vise No.	Width of Jaws, Inches
130	3
135	3½
140	4
145	4½
150	5

A specially designed locking nut permits all the advantages of Swivel Base Vise, and yet the rigidity, strength and durability of the Stationary Base Vise.

We will gladly quote on your requirements or send illustrative material upon your suggestion to do so.

WRITE

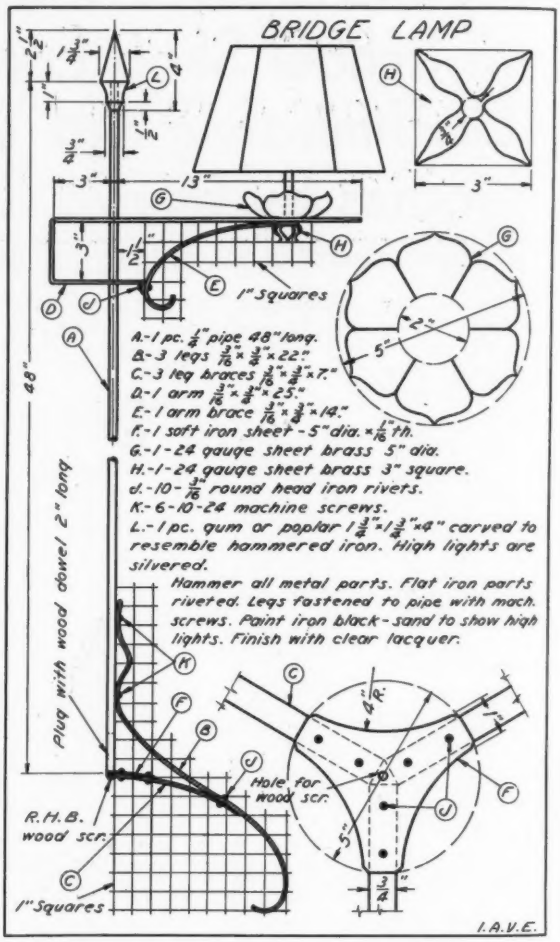
MORGAN VISE CO.

120 N. Jefferson St., Chicago, Ill.

(Continued from page 74)

Flesh: A small amount of pink added to yellow produces flesh color.

Gray: A small quantity of black, when added to blue, produces gray. To lighten the gray, white must be used. The amount of black used, governs the shade of gray produced.


BRIDGE LAMP
A-1 pc. ¼" pipe 48" long.
B-3 legs ⅞" × ¾" × 22".
C-3 leg braces ⅛" × ¾" × 7".
D-1 arm ⅜" × ¾" × 25".
E-1 arm brace ⅛" × ¾" × 14".
F-1 soft iron sheet - 5" dia. × 1/16 th.
G-1-24 gauge sheet brass 5" dia.
H-1-24 gauge sheet brass 3" square.
d-10-3/16" round head iron rivets.
K-6-10-24 machine screws.
L-1 pc. gum or poplar 1¾" × 1¾" × 8" carved to resemble hammered iron. High lights are silvered.
Hammer all metal parts. Flat iron parts riveted. Legs fastened to pipe with mach. screws. Paint iron black - sand to show high lights. Finish with clear lacquer.
Plug with wood dowel 2" long
48"
1" Squares
R.H.B. wood scr.
Hole for wood scr.
I.A.V.E.

Bridge lamp, designed by Richard Noyes, Moorestown, New Jersey

CIRCULAR SAWS, THEIR CHARACTERISTICS AND USE — VIII

John E. Doren, Supervisor of Industrial Education, Eureka, California

(Continued from October 1933)

Section IV — Groover Saws

Definitions

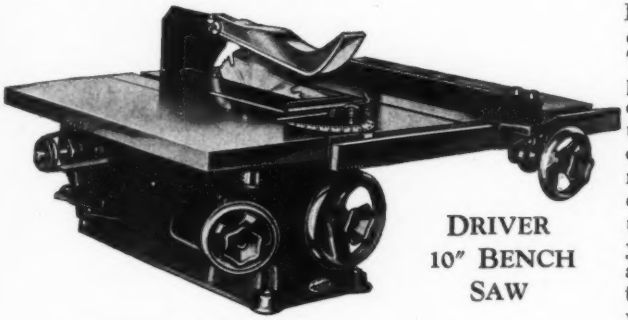
Groove: A groove is a channel of any cross sectional shape made in the surface of a piece of lumber, regardless of its relation to the grain of the wood, or to any other surface of the same piece. The term "groove" is a very general term.

Plow: This is the trade term commonly used for a channel of rectangular cross section cut into one surface of a piece of lumber and parallel to one of the other faces or edges. The direction of a plow is approximately in the general direction of the grain (see Fig. 17).

Dado: This is the common term for a channel of rectangular cross section cut across the grain of the wood when the channel is cut across one of the broad faces. Even though most dados are cut approximately square across a face, the term applies to a channel cut diagonally across the face also.

(Continued on page 79)

new DRIVER TOOLS increase the scope of school shop work



DRIVER 10″ BENCH SAW

Cuts full depth to 3¼″.

Table is made of annealed gray cast iron 15″ x 21″ without extensions, 31″ x 21″ with extensions.

Base has removable plate for changing saw blades, base extension carries floating motor base which provides proper belt tension automatically.

Equipped with enclosed, dust-tight S.K.F. Ball Bearings.

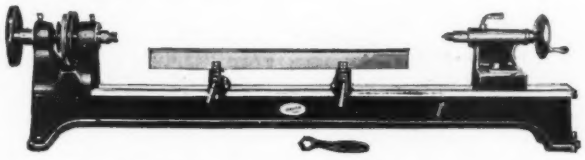
Arbor is machined steel ¾″ in diameter at bearings. Size at saw ⅝″. Pulley size ⅝″. Raised and lowered on 1¾″ solid steel rack and cut steel pinion.

Table tilts on steel fulcrum with convenient locking and adjusting wheels.

Ripping fence is 25″ x 1½″ x ⅝″. Locks front and back, and guide bar indicates scale in inches.

Newly designed guard and splitter give complete protection without interference at all times.

Weight (shipping) of model B911 shown above is 215 lbs. without the motor.



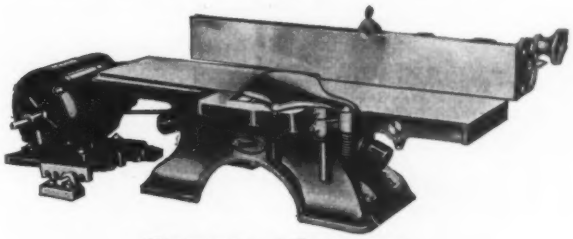
DRIVER WOODWORKING LATHE

This remarkable tool has a swing of 10¼″. The bed is made of rigid cast-iron aged to insure permanent accuracy. The length overall is 57″ and distance between centers is 37″. The hollow head spindle turns on pre-loaded S.K.F. Ball bearings, a double row at the front and a single row at the back. The front end of the spindle has a right hand thread for the face plate and the opposite end a left thread for large face plate work. This remarkable tool is built with the strength and mechanical precision required for metal turning and is equally as efficient when turning large, bulky pieces of wood as when turning small diameter dowels. The shipping weight is 180 lbs.

Listed below are other Driver Power Tools. Address Dept. IA9 for complete details.

BAND SAW	FLEXIBLE SHAFTS
SHAPER	JIG SAWS
GRINDERS	MOTORS
CLUTCHES	ACCESSORIES

In selecting school shop equipment, you can be certain that a choice of these new Driver Power Tools will prove most beneficial. They incorporate advanced mechanical improvements and conveniences which increase their utility to an unbelievable degree. Even at full capacity on daily production work these rugged tools will maintain their unvarying precision and accuracy over a period of many years. Skilled workmen using only the finest materials construct them, yet if yours is the leanest of budgets it will be ample to purchase these splendid machines for they're surprisingly inexpensive. We can give you but a glimpse at their many features below, but at your request we'll gladly send detailed information, on these and other Driver Tools.



DRIVER 4″ JOINTER

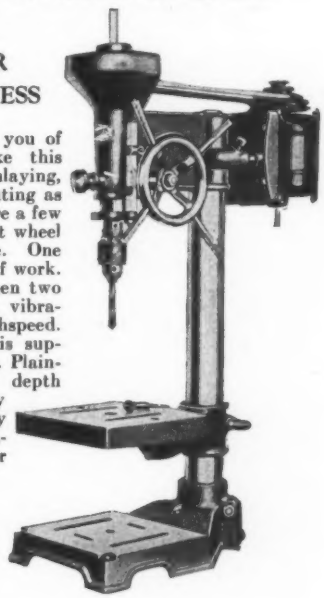
The overall length of this tool is 28″, width 10¾″, height 7½″, shipping weight (without motor) 98 lbs.

It is equipped with 3 high speed steel knives and has S.K.F. sealed, dust-tight Ball Bearings.

The balanced cutter head is 4½″ long, safety type, and is integral with the shaft. It is machined from solid bar steel. Fence tilts 45° right or left, being controlled by a spur gear. Base is of one piece construction, with ways and bearing supports carefully machined. Spring tensioners usually employed to hold tables to base are eliminated in favor of positive grip nuts which assure correct alignment.

NEW DRIVER "900" DRILL PRESS

We haven't space to tell you of the features which make this tool ideal for carving, inlaying, mortising, dovetailing, routing as well as drilling, but here are a few of its many features. Pilot wheel feed increases convenience. One spindle used for all types of work. Pulley is suspended between two S.K.F. bearings relieving vibration particularly at highspeed. Jacob's ½″ Key Chuck is supplied as regular equipment. Plainly indicated square steel depth gauge adds to the accuracy of this tool. There are many other exclusive Driver features fully described in our free illustrated catalog.

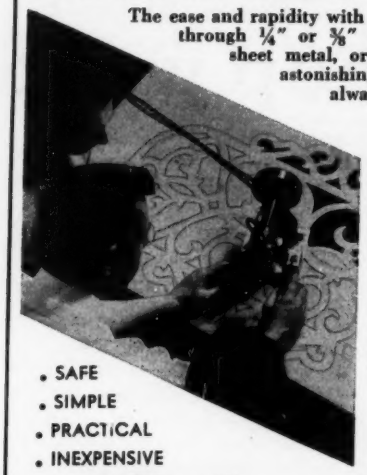


WALKER-TURNER CO., INC.

Plainfield, N. J., U.S.A.

SOMETHING NEW!

The ease and rapidity with which a Cutawl cuts through ¼" or ⅜" plywood, wallboard, sheet metal, or what have you, is astonishing. Stage sets you've always wished you could make for your school, signs you've wanted your boys to make for years, design patterns in toys, furniture of all kinds, and a thousand and one projects beyond the range of your equipment or hand tools are now possible when a Cutawl helps you.



- SAFE
- SIMPLE
- PRACTICAL
- INEXPENSIVE

The Cutawl

FREE DEMONSTRATION

To demonstrate just how the Cutawl does its work we will gladly arrange to have one of our representatives call at your convenience to show you in your own shop exactly what the Cutawl will do. Of course, you assume no obligation

or

if you prefer, we will merely send you descriptive circulars upon receipt of your request.

INTERNATIONAL REGISTER COMPANY

29 S. Throop Street Chicago, Illinois

ART METAL and JEWELRY WORK EQUIPMENTS and SUPPLIES

We make a specialty of equipping and supplying schools, clubs and summer camps for this work and carry all kinds of materials used, including gold, silver, copper, brass, pewter and nickel silver, in sheet and wire form, and semi-precious stones.

"Rose" anvils and hammers.
The first to be used in school work. Beware of inferior substitutes. **Specify "Rose"** when ordering.
We take pride in our reputation for service. No order or request too small to receive our prompt and careful attention.
Our Brochure "The Metal Crafts" is full of helpful suggestions. Sample copy sent free. Subscription price for three issues, 50c.

Send for our catalog R.

Metal Crafts Supply Co.
37 Aborn St., Providence, R. I.

A Better Position

YOU CAN GET IT

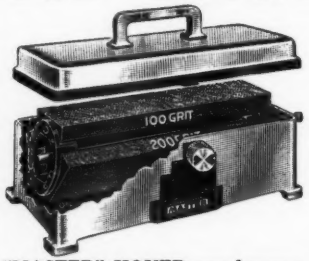
Hundreds of teachers will earn two hundred dollars or more this summer. SO CAN YOU. Hundreds of others will secure a better position and a larger salary for next year. YOU CAN BE ONE OF THEM. Complete information and helpful suggestions will be mailed on receipt of a three cent stamp.

Continental Teachers Agency, Inc.
1812 Downing St. Denver, Colo.

Covers the ENTIRE United States

School Officials! You may wire us your vacancies at our expense, if speed is urgent. You will receive complete, free confidential reports by air mail within 36 hours.

OIL STONE HONER



Teach correct way of hand sharpening all edged tools on MASTER oil stone honer.

Vitrified stones 10¼" x 2½", reversible, rotate on axle in oil; instantly locked securely in position. Iron non-leak case with durable finish, rubber feet.

"MASTER" HONER supplements and improves present sharpening equipment. Keeps tools sharper and prolongs life. Made in 3 stone (illustrated) and also 2 stone models. Write for prices and circular.

WISCONSIN ABRASIVE CO.
130 W. Pittsburgh Ave. Dr. 9572 Milwaukee, Wis.

No. 475 Plurality

PLURALITY OILSTONE TOOL GRINDERS

Meet School Shop Needs

Now available in 3 sizes
No. 425 Plurality Sub Jr.
No. 450 Plurality Jr.
No. 475 Plurality

Here is the most efficient, serviceable and convenient tool sharpening machine ever made. Now in three sizes to suit every need. Combines five basic units in one: *Coarse oilstone wheel, fine oilstone wheel, grinding cone, leather stropping wheel, and emery wheel*—Compact—Easily Accessible. Especially guarded for school shop use. Has ball bearing direct motor drive.

Write for detailed information.

Mummert-Dixon Co.
HANOVER, PA.

Originators and Pioneer Manufacturers of Oilstone Tool Grinders

(Continued from page 76)

Notch: This is the better term for a channel cut across an edge in contrast to the dado which is cut across a broad face (see Fig. 18).

Slot: This is the trade term frequently used for a channel of rectangular cross section cut into the end of a piece of lumber (see Fig. 19).

FIG.17

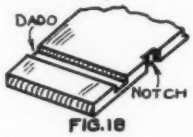


FIG.18

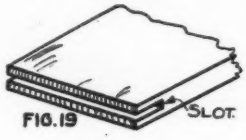


FIG.19

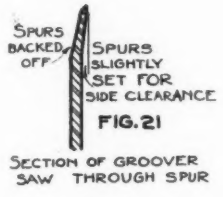
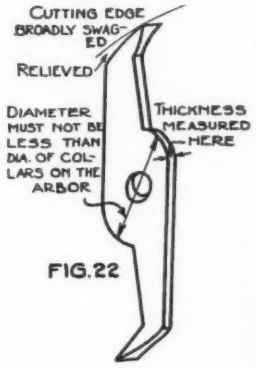


FIG.21
SECTION OF GROOVER SAW THROUGH SPUR

GROOVER SAW. THE TEETH ARE GROUPED. TWO SETS OF SPURS TO EACH RAKER
FIG. 20


CUTTING EDGE BROADLY SWAGED
RELIEVED
DIAMETER MUST NOT BE LESS THAN DIA. OF COLLARS ON THE ARBOR
THICKNESS MEASURED HERE
FIG.22

Groover Saws

(Huther Bros. Patent Tooth)

A. Purpose. The real purpose for which groover saws are made is:

1. Grooving:

a) For cutting rectangular channels in lumber parallel to a true face or a true edge: for "plowing."

b) For cutting rectangular channels perpendicular to the edge of lumber, that is, across the grain, viz., for "dadoing," and also for "notching."

c) For cutting rectangular channels in the ends of lumber parallel to a true face, viz., for "slotting."

2. For accurate and smooth grooving.

B. Characteristics of the groover saw:

1. The body is:

a) Of uniform gauge throughout.

b) Made in standard thicknesses ⅛ to ½ in. by 16ths.

2. The teeth are:

a) Grouped. Two sets of spurs to one rip tooth (see Fig. 20).

b) The spur sections are slightly:

(1) Set for side clearance — approximately 1/100 in., and

(2) Backed off for easy setting and filing (see Fig. 21).

(3) The spur teeth are usually filed with their front edges slightly raking.

(4) The spur teeth are usually filed with pronounced bevel on both fronts and backs.

c) The rip teeth or "rakers" are:

(1) Neither set nor swaged, and are

(2) Dressed approximately 1/64 in. shorter than the spur teeth.

C. The groover saws are designed for:

1. Making shallow grooves.

2. Cutting in dry, well-seasoned lumber.

3. Smooth cutting.

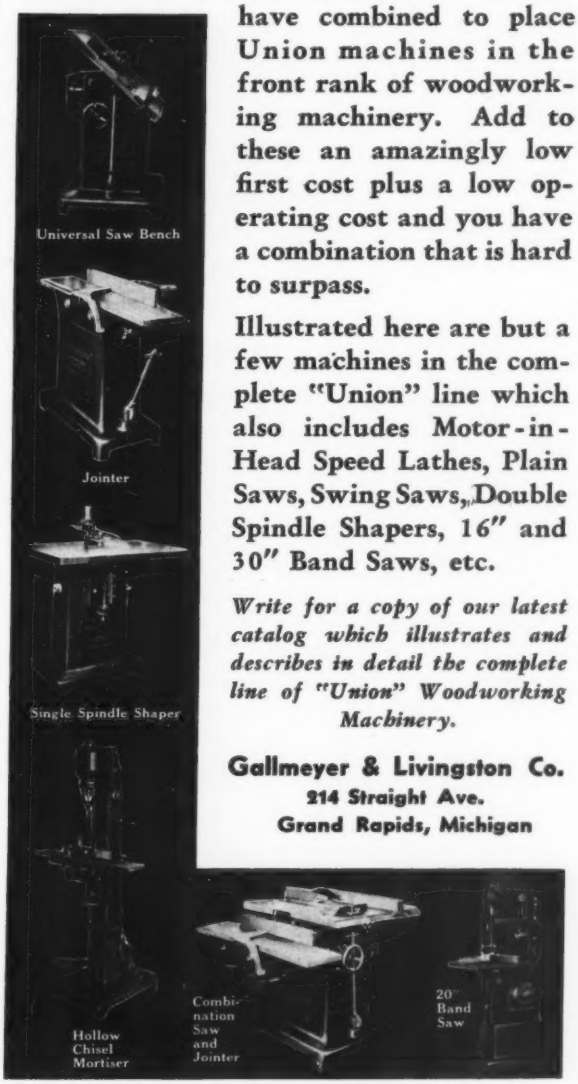
(Continued on page 85)

GALLMEYER & LIVINGSTON MACHINES MEET SCHOOL NEEDS EXACTLY

"UNION" WOOD WORKING MACHINERY

The far-flung acceptance of the "Union" Line of woodworking machinery by school shop men has been based on sound, efficient economy and the superior service these machines render. Compact, portable and specially safeguarded Union Machines have been designed, after a careful study of school requirements, to exactly fill the shop instructor's needs.

Effortless ease of operation, maximum speed in turning out work, a strength and ruggedness far in excess of normal requirements, are just a few of the features that have combined to place Union machines in the front rank of woodworking machinery. Add to these an amazingly low first cost plus a low operating cost and you have a combination that is hard to surpass.



Illustrated here are but a few machines in the complete "Union" line which also includes Motor-in-Head Speed Lathes, Plain Saws, Swing Saws, Double Spindle Shapers, 16" and 30" Band Saws, etc.

Write for a copy of our latest catalog which illustrates and describes in detail the complete line of "Union" Woodworking Machinery.

Gallmeyer & Livingston Co.
214 Straight Ave.
Grand Rapids, Michigan

Metal-Working Equipment and Supplies

Teachers and supervisors may find these maximum lists helpful in checking their inventories or preparing their budgets.

Name and Description	No.	Name and Description	No.	Name and Description	No.
Air Compressors, for machine shop, foundry, or forge shop		**Desk**		Change gear, 9″ to 14″ swing, 18″ to 36″ between centers	
Anvil, 100-lb.		Teacher's, with drawer compartments		Quick-change gear, 9″ to 16″ swing, 18″ to 36″ between centers	
Arbor Press, bench or pedestal type		Chair, to match desk		Semiquick-change gear, 9″ to 18″ swing, 18″ to 42″ between centers	
Barrows		**Die-Filing Machine**		Turret	
Coke		**Dividing Head**		**Milling Machine**	
Foundry		**Drill**		Plain, cone or motor-driven type	
Scrap		Bench, hand		Universal, cone or motor-driven type	
Belt Lacer		Breast		**Nibbling Machine**	
Benches		Electric, portable		**Pipe Cutter**	
Coremaking		Hand		**Planer,** belt or motor driven	
For metal working, iron or steel legs. Tops metal or hardwood lumber 1¾ to 2½ in. thick		Post, hand or power		**Power Hammer,** for forging operations	
Molding		Radial		**Punches,** metal, hand or power	
Blackboard		Sensitive		**Pyrometer**	
Permanent or portable		Upright, power		**Pyroscope**	
Blowers, for furnaces, forges, etc.		**Flasks,** 2 or 3 part, steel or snap type		**Relieving attachment for Lathe**	
Blowtorch, 1-qt. size		**Forge,** coal or gas, with hand- or electric-driven blower		**Sandblast Outfit,** with cabinet	
Bookcase		**Furnaces**		**Sand Sifter,** for foundry, hand or power	
For reference books, catalogs, etc.		Annealing		**Scale**	
Boring Bar		Bench		Counter, for machine shop	
Boring Mill, vertical or horizontal		Brass and soft metal		Platform, for foundry, 1000-lb. capacity	
Bulletin Board		Combination bench		**Shaper**	
Cabinets, wood or metal, for filing class records, instruction sheets, drawings, etc., or for tools and supplies		Casehardening		**Slotter**	
Casehardening Boxes		Cyanide		**Snap-Flask Jackets,** to fit snap flasks used	
Centering Machine		Gasoline		**Straightening Press**	
Chain Hoists, differential, duplex or triplex		Heat treating		**Surface Plates**	
Chairs, tablet-arm if needed for related-subjects room, or demonstration section		Melting		**Swage Block and Stand,** for forge shop	
Chuck		**Gear-Cutting Machine**		**Taper Attachment for Lathe**	
Drill, selected sizes, each		**Grinder**		**Truck,** warehouse	
Lathe, combination, 4-jaw, selected sizes, each		Bench, hand or power driven		**Tumbling barrel,** for the foundry	
Lathe, independent, 4-jaw, selected sizes, each		Combination grinder, buffer and polisher		**Vises**	
Lathe, universal 3-jaw, selected sizes, each		Emery, bench or pedestal type		Blacksmith	
Milling machine, universal		Face, with magnetic chuck		Drill press	
Core Oven, for foundry		Portable tool post		Machinist	
Cranes and Hoists, air, electric or hand, of the jib, traveling, or portable type		Precision, for external and internal grinding		Pipe	
Cupola, for foundry, coke or electric, ¼ to 1-ton capacity		Universal tool-cutter, drill and reamer grinder		Planer	
		Wet tool		Shaper	
		Hand Picks, for cleaning inside of cupola, 1¼ to 2½ pounds		**Welding Outfit**	
		Hack Saw, motor or belt driven		Acetylene	
		Hardness Testing Machine		Electric	
		Lathes, belt or individual drives			
		Automatic			
		Bench, 6″ to 11″ swing, 11″ to 36″ between centers			

Metal Working—Small Tools

Name and Description	No.	Name and Description	No.	Name and Description	No.
Arbors		ers and shell drills, selected sizes, each		Core box	
Drill chuck to suit requirements		**Bearing Scraper, sets**		Core painting	
Reamers, various sizes, each		**Bellows,** for foundry class		Hard brushes for the foundry	
Shell tool, various sizes, each		**Bevel Protractor**		Soft brushes for the foundry	
Straight shank for shell reamers and shell drills, selected sizes, each		**Brooms and Floor Brushes,** for shop and foundry		**Bulb Sponges,** for molders	
Taper shank for shell ream-		**Brushes**		**Draw Pins,** for molders	
		Bench		**Calipers**	
				Hermaphrodite, 4″	
				Hermaphrodite, 6″	

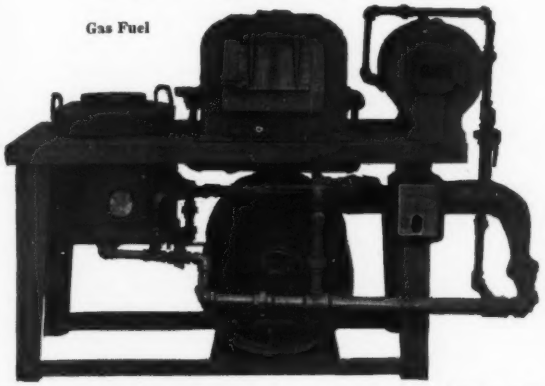
(Continued on page 82)

FURNACES STEWART FORGES

The furnaces and combinations here shown are just several of a variety designed and developed for the school shop.

Stewart Triple Purpose Furnace

Gas Fuel



This very complete and compact unit is very popular for educational purposes and the toolroom—an assembly of three of our standard Stewart Furnaces making a complete, compact plant covering practically the whole range of the heat treatment of metals on a small scale.

Crucible section for lead, cyanide, or salt hardening fitted with 6″ x 12″ pressed steel pot. Interchangeable to accommodate a No. 12 graphite crucible for metal melting.

Oven section for general heat treating of carbon or high speed steels.

High speed section for tool dressing, rod end work, and forging.

The illustration above shows a Turbo Blower mounted below the table with push button starter.

A very complete and space-saving unit. Can be furnished in other combinations.

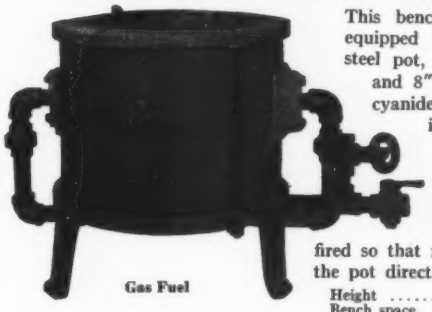
No. 4A Bench Metal Melting Furnace

This melter is fitted with a No. 4 Graphite crucible, lined with heavy firebrick and fitted with a swinging cover for the melting of brass, copper, and aluminum. Assures fast, quick heats.

Gas Fuel

Height .....19″
Bench space .....20″ x 24″
Shipping weight.....180 lbs.

No. B68 Round Pot Furnace

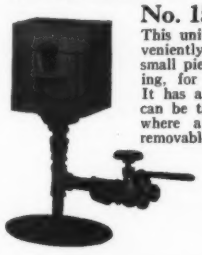


This bench type unit is equipped with a pressed steel pot, 6″ in diameter and 8″ deep, for lead, cyanide, or salt hardening. Can also be used for oil tempering. Lined with heavy refractories and fired so that no flame strikes the pot direct.

Gas Fuel

Height .....19″
Bench space.....20″ x 24″
Shipping weight .....170 lbs.

No. 152 Forge—Ideal for Small Work



This unit is very handy and one that can be placed conveniently on a bench or small table for the heating of small pieces to be forged, for the heating of rods for bending, for tool dressing, and for the taking of end heats. It has a small opening at both ends so that center heats can be taken or it can be worked from both ends. Ideal where a quick intense heat is required. The top is removable to handle a wide variety of work.

Entrance.....1¼″ x 1¼″
Bench space.....12″ x 12″
Overall height.....15″
Shipping weight.....60 lbs.

Two Purpose Furnace

The Unit on the left is used for cyanide hardening, lead hardening, or other liquid heat for hardening. It can be used for melting soft metals. It is fitted with a pressed steel pot 6″ diameter x 6″ deep or 6″ diameter x 8″ deep.

Specifications

Gas connection .....1″
Air connection.....1″
Floor space .....48″ x 18″
Shipping weight.. 500 lbs.

SK 248 Forge

A sturdy, well built forge designed for tool dressing, rod end work, heating for bending, welding, the taking of center heats, and many other purposes where a fast high heat is required. Welding temperature secured in 20 minutes. Fitted with air curtain in front to protect the operator and equipped with a proportional gas and air mixer and a quenching tank with rack for tongs.

Opening.....4″ wide x 2″ high
Heating depth.....8″
Rear opening.....3″ diameter
Shipping weight.....450 lbs.

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(Continued from page 80)

Name and Description	No.	Name and Description	No.	Name and Description	No.
Inside, 4".....		Flat bastard, 8" and 10", each		**Punches**	
Inside, 6".....		Half-round, double cut, 6", 8", and 10", each.....		Center, ¼" and 3/16", each....	
Outside, 4".....		Hand, smooth, 8" and 10", each		Hollow, ½", ¾", and 1", each	
Outside, 6".....		Mill, smooth, 8" and 10", each		Pin, 1/16", 3/32", 1/8", 5/32", and ¼", each	
Cans		Round bastard, 8".....		Prick, ¼".....	
Oil, ½-pt.....		Square bastard, 8".....		**Rammers**	
Oil, 1-pt.....		Swiss, various shapes, each.		Hand, for foundry.....	
Oil, 10-gal.....		Three-square, double cut, 6"		Floor, for foundry.....	
Waste		Warding, double cut, 6".....		**Reamers**	
Center Testers		**First-Aid Cabinet and Supplies**		Adjustable, various sizes, each	
Chisels		**Forge Tools**		Hand, various sizes, each...	
Cape, 3/16" and 5/16", each.....		Drift pins, flatters, fullers, hand and handle punches, hardies, hot and cold cutters, set hammers, and swages for the forge shop.		Taper pin, various sizes, each	
Cold, 5/16" and ¼", each.....		**Gate Sticks,** maple, for foundry		With taper shank, various sizes, each	
Diamond point, 3/16" and ½", each		**Gauges**		**Riddles,** ¼" and ½" mesh, 18" diameter, for the foundry, each	
Round nose, 3/16" and ½", each		Center		**Rivet Sets,** assorted sizes, each	
Clamps, 4" and 6", each.....		Depth		**Scales**	
8" and 10", each.....		Drill and wire.....		Steel, 6", graduated 1/64" to 1/8"	
Flask, for the foundry.....		Screw pitch, select kinds, each		Steel, 12", graduated to 32nds	
Strap, various sizes, each...		Surface		**Screw Drivers**	
Coke Forks, for foundry.....		**Gloves,** asbestos, for foundry		6" blade.....	
Collets		**Goggles**		9" blade.....	
For milling machine, selected sizes, each		For machine shop.....		**Scribers**	
For lathe, selected sizes, each		For foundry		**Shovels**	
Combination Squares, with hardened head and blade, and protractor head, 9" and 12", each		**Hack Saw**		Coke	
Counterbores, straight and tapered shanks, selected sizes, each		Blades, hand, 18T, 10", doz..		Sand	
Countersinks, for metal.....		Blades, power, 14T, 12", doz.		**Snips**	
Crucibles, of suitable sizes, each		Frames, adjustable		Straight, 3" cut.....	
Shanks, single, end to fit ladles		**Hammers**		Curved, 3" cut.....	
Shanks, hand, to fit ladle bowls		Babbitt		**Sockets,** for taper shanks, drill and tools, selected sizes, each	
Crucible Tongs, to fit crucibles, each		Ball-peen, 13-, 16-, or 20-oz..		**Soldering Coppers and Handles,** 1-lb. size.....	
Cutters		Blacksmith's, various kinds, each		**Spray Can,** for molders.....	
Angular-milling		Riveting, 9- and 12-oz., each.		**Sprinkling Cans,** galvanized iron, 16-qt. capacity, for the foundry	
Bevel-gear		Setting		**Sprue Picks,** for molders.....	
Concave-milling		**Indicator**		**Squares**	
Convex-milling		Center		Machinists', 6".....	
End-milling		Universal or universal dial test, each		Blacksmith's	
Face-milling		Speed		**Steel Figures,** 1/16", sets.....	
Formed-milling		**Knurling Tool,** with assorted knurls		**Steel Letters,** 1/16", sets.....	
Grooving		**Ladles**		**Swabs,** for molders.....	
Involute gear teeth.....		Bull		**Tapeline,** steel, 25'.....	
Key-seat		Hand bowls		**Taps and Dies**	
Side-milling		Melting		Machine Screws, sets.....	
Metal-slitting		**Lathe Dogs,** ½", ¾", 1", 1½", 2", 2½", and 3", each.....		Pipe, sets	
Dividers		**Leggins,** fireproofed duck, to protect students when pouring in the foundry, pairs....		S.A.E. ¼" to ¾", sets.....	
Spring, 4".....		**Level,** 6" bench.....		U.S.S. ¼" to ¾", sets.....	
Spring, 6".....		**Lifting Screws,** for molders...		**Tongs**	
Drill		**Mandrels,** selected sizes, each.		Blacksmith's, various kinds, each	
Drifts, different sizes, each..		**Mallets,** wood or soft face....		Pick-up, for the foundry....	
Drill sleeves, different sizes, each		**Micrometers**		Shake-out, for the foundry..	
Stand for Nos. 1 to 60.....		Inside, 1½ to 8".....		**Tool Holders**	
Stand for 1/16" to ½" by 64ths		Outside, 0" to 1".....		Boring tools	
Drills		Outside, 1" to 2".....		Cutting-off tools	
Center		Outside, 2" to 3".....		Planer	
High-speed, taper shank, various sizes, each.....		**Molding Boards**		R.H. and L.H. offset shank.	
Jobbers, straight shank, 1/16" to ½" by 64ths, each.....		**Molding Sticks and Trowels,** various kinds, each.....		Shaper	
Ratchet		**Nippers,** end-cutting, 5".....		Slotter	
Straight-shank, Nos. 1 to 60, each		**Oilstones,** medium and fine, each		Straight shank	
Taper shank, ½" to 1" by 16ths, each.....		**Oil Storage Tank,** with pump.		Threading	
Emery		**Pails,** galvanized, 12-qt. capacity for the foundry.....		**Tool-Holder Bits,** square, ¼", 5/16", 3/8", 7/16", ½"	
Rub-stones for cleaning castings in the foundry.....		**Parallels**		**Trammel Points,** sets.....	
File Card.....		Adjustable		**V Blocks and Clamps,** pairs...	
Files		Steel, assorted sizes, each...		**Wheel Dresser**	
Die sinkers, various shapes, each		**Pliers**		**Wrenches**	
		Combination, 6".....		Adjustable, 8" and 10", each.	
		Side-cutting, 6".....		Pipe, 8" and 12", each.....	
				Tap, adjustable, various sizes, each.....	

(Continued on page 84)

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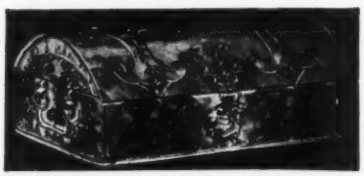

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AMERICAN SHEET AND TIN PLATE COMPANY, Pittsburgh, Pa.

SUBSIDIARY of UNITED STATES STEEL CORPORATION

(Continued from page 82)

Metal Working—Materials and Supplies

Name and Description	No.
Abrasive Wheels	
Acetylene Gas, in drums, for welding	
Aluminum Pigs, for foundry	
Babbitt Metal	
Bearing Blue, tubes	
Belt Dressing	
Belt Lacing Material	
Belt Leather	
Bolts	
Carriage, selected sizes, lots of 100 each	
Lag, selected sizes, lots of 100 each	
Machine, selected sizes, lots of 100 each	
S.A.E., selected sizes, lots of 100 each	
Stove, flat or round heads, selected sizes, in lots of 100 each	
Brass	
Bars, 3/32", 1/8", 5/16", and 1/4" thick; 3/8" to 1" wide, 8' to 10' long, selected sizes, each	
Round Rods, 5/16" to 1/2" by 16ths, selected sizes, feet each	
Sheets, 28 to 32 American gauge, 12" wide by 72" to 84" long, selected sizes, sheets, each	
Strips, 1/32" and 1/16" thick, 1/2" to 1 1/2" wide, 50 ft. to a coil, selected sizes, coils each	
Threaded Rods, Nos. 6 to 10, come in 12" lengths. Nos. 12, 14, 1/4", and 5/16" come in 24" lengths, selected sizes, rods	
Wire, soft, 8, 11, and 14 American gauge, selected sizes, lb.	
Wire, spring, 8 to 22 American gauge, selected sizes, lb.	
Casehardening Compounds	
Chaplets, single and double head	
Coal	
Charcoal for foundry or forge	
Coke for foundry	
Forge	
Copper	
Pigs, for casting alloys	
Sheets, 8 to 25 American gauge. Size of sheets, 30" x 60". Selected sizes, sheets, each	
Tubing, outside diameters, 1/16", 1/4", 5/16", 3/8", 1/2", thickness of wall, 1/32", lengths, 8' to 12'. Selected sizes, lengths each	
Wire, soft, 2 to 20 American gauge, in coils. Also obtainable in 1/4-, 1/2-, and 1-lb. spools, in sizes 16 to 36 English gauge. Selected sizes, pounds each	
Core	
Compounds	
Flour	
Paste	
Oil	
Wax-vent wire	
Cutting Compounds	
Emery Paper and Cloth	
Nos. 00, 0, 1/2, 1, obtainable in sheets or rolls. Selected sizes. If in sheets, quires each	
In rolls, rolls each	
File Handles, assorted sizes, each	
Fire Bricks and Clay, for foundry	
Graphite, for foundry	
Iron	
Pig, for foundry	
Lacquer, transparent and colored, for finishing	
Nuts	
S.A.E., acorn cap, castellated, square, hexagon, joint, and wing. Selected sizes and kinds. Lots of 100 each	
Oil	
Boiled linseed, gal	
Lubricating, gal	
Quenching and hardening	
Packing	
Round, sheet, square, or tubular	
Paint, black asphaltum	
Pins	
Cotter, 3/32" to 1/4" diam. from 1/2" to 2" long. Obtainable in boxes containing an assortment of 120 cotters	
Flask, for flask repairs	
Taper, Nos. 0 to 6, 3/4" to 2" long. Obtainable in boxes containing 40 assorted pins	
Pumice Powder	
Rivets	
Copper, with burrs, Nos. 7 to 14, lengths, 3/8" to 3/4". Selected sizes, 1/2-lb. boxes, each	
Iron, No. 14 gauge to 5/16", flat-head or button-head, 1/4" to 1" long. Selected sizes, lb. each	
Tinners, flat-head, 8-oz. to 16-lb., either tinned or black. Selected sizes, lb. each	
Sand	
Molding, can be had in 350-lb. barrels or 800-lb. casks.	
Parting, can be had in 350-lb. barrels or 800-lb. casks	
Screws	
Flat-head or round-head, iron or brass. Selected sizes and kinds, per hundred, each	
Cap and machine, iron or brass. Selected sizes and kinds, per hundred, each	
Set, head and headless	
Solder	
Acid or rosin core; bar, or solid wire	
Soldering Paste or Salts	
Steel	
Bessemer, rod, 3/16" to 3/8" by 64ths, in 4' lengths. Selected sizes, lengths, each.	
Bars, cold-rolled, 1/8" to 3/8" thick, 1/2" to 2" wide, 12' lengths. Selected sizes, lengths, each	
Drill rod, letter sizes, A to Z; number sizes, 1 to 80. Comes in 3' lengths. Selected sizes, lengths, each.	
Rods, hexagon and square, cold-rolled, 1/4" to 3/4". Comes in 12' lengths. Selected sizes, lengths, each.	
Round, cold-rolled, diameters 1/8" to 1", lengths 12'. Selected sizes, lengths, each	
Sheet, black, Nos. 18, 20, 22, 24, 26, 28 U.S. gauge; size of sheets, 24", 28", and 30"x 96". From 4 to 13 sheets in a bundle. Selected sizes, bundles, each.	
Sheet, galvanized, Nos. 18, 20, 22, 24, 26, 27, and 28 U. S. gauge; size of sheets, 24", 28", and 30"x 96". From 4 to 12 sheets in a bundle. Selected sizes, bundles, each	
Threaded rods, Nos. 6 to 10. Come in 12" lengths. Nos. 12, 14, 1/4", and 5/16". Come in 24" lengths. Selected sizes, rods each	
Tin	
Pigs, for casting alloys	
1C, 1X, 20"x 48", 112 sheets to the box	
1XX, 20"x 48", 56 sheets to the box	
Washers and Burrs	
Copper, burrs, Nos. 3 to 14, in 1-lb. boxes	
Iron burrs, Nos. 3 to 14, in 1-lb. boxes	
Brass washers, 5/16" to 1/2" by 16ths	
Iron washers, 5/16" to 1/2" by 16ths	
Welding Fluxes	
Welding Rods, all rods come in 24" lengths	
Brazing, 1/16", 1/8", and 3/16" diameter	
Cast aluminum, 3/16", 1/4", and 3/8" diameter	
Cast brass, 3/16", and 1/4" diameter	
Cast bronze, 1/4" diameter	
Cast copper, 3/16" and 1/4" diameter	
Cast iron, 3/16", 1/4", 5/16", and 3/8" diameter	
Low carbon steel, 1/16", 3/32", and 1/4" diameter	
White Lead, for machine shop, lb.	
Wire	
Annealed, 16 to 34 English gauge. Selected sizes, lb. each	
Coppered market, 5 to 18 English gauge. Selected sizes, lb. each	
Coppered spring, 2 to 18 English gauge. Selected sizes, lb. each	
Galvanized, 5 to 18 English gauge. Selected sizes, lb. each	
Piano, 00 to 36. Selected sizes, lb.	
Tinned, 16 to 24 English gauge. Selected sizes, lb. each	
Wool, No. 0 to 3 in pound packages. Selected sizes, lb. each	
Zinc	
Pigs, for casting alloys	
Sheet, Nos. 4 to 14. Sheets 36"x 84"	

(Continued from page 79)

4. Cutting material that is flat and true on the guiding faces.

5. Use only in connection with proper gauges and fences.

6. Convenience. Groover saws will cut equally well with or across the grain.

7. Accurate cutting.

D. Operation of groover saws:

1. Cutting must not be hurried or forced.

2. A groover saw must always be placed on the saw arbor in the same relative position as when it was jointed.

3. The sides of the saw blades and the faces of the collars and washers must be clean and free from lumps of gum and dirt, to insure the saws running without wabble.

4. If a saw is unusually noisy in a cut, the saw should be removed from the arbor and its sides and the faces of the collars and washers should be cleaned, for a noisy saw is usually a wabbling saw. If this does not correct the difficulty, the saw should be tested for lumps. A noisy saw, from whatever cause, will do inferior work.

5. A single groover saw ⅛ in. thick may be used for any cutting that may be done with a combination-tooth, hollow-ground saw and must be used under the same operating conditions as apply to the use of the hollow-ground saw.

Questions for Thought and Discussion

1. What is a groover saw?
2. Describe a groover saw of the Huther pattern.
3. In what particulars or characteristics does the Huther pattern differ from the Disston pattern groover saw?
4. How is side clearance provided in the Huther groover saw?
5. For what class of work is the groover saw designed?
6. Should the groover saw make a clean, smooth cut or a rough, ragged cut? Why?
7. How is it possible for the groover saws to cut successfully either "with" or "across" the grain?

The Dado Head

(Huther Pattern)

A. Purpose. The outstanding purpose for the dado head is convenience; a large range and variety of grooving is possible with a limited investment in equipment, viz.,

1. Plowing — cutting channels lengthwise of the grain,
2. Dadoing — cutting channels crosswise of the grain,
3. Slotting — cutting channels through end grain, and
4. Rabbeting — cutting recesses at ends or edges of lumber.

B. Characteristics of the dado head:

1. A group of saws and inside cutters:

a) Two thin groover saws (Huther Pattern) ⅛ in. thick.

b) One or more inside cutters of standard thickness, 1/16 in., ⅛ in., ¼ in.

(1) The cutting edges of the inside cutters are heavily swaged.

(2) The ends of the cutters are slightly relieved for clearance.

(3) The diameter of the cutter at the eye is no smaller than the diameter of the collars on the arbor.

(4) The thickness of inside cutters is measured at the eye (study Fig. 22).

Note: Good practice dictates that all of the inside cutters shall be marked with a crowfoot or arrowhead witness mark at the eye just the same as the circular saws, and when the cutters are mounted on an arbor, the witness mark should be up (see Fig. 4 with notes).

2. The assembled dado head consists of:

a) Two thin groover saws together, or

b) Two thin groover saws with one or more inside cutters of the same cutting diameter between them, to make the desired width of groove.

(Continued on page 86)

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Reading Shop Blueprints (with prints)	200 pp.,	152 illus.,	2.75
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Carpentry (3 Vols.)	487 pp.,	353 illus.,	5.00
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Architectural Drawing (with plates)	157 pp.,	94 illus.,	2.25
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Bench Work	104 pp.,	103 illus.,	1.25
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Progressive Lessons in Printing (40 Lessons)	134 pp.,	39 illus.,	1.50
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(Continued from page 79)

c) The swaged points of the inside cutters that are next to the groover saws, must be opposite the gullets of the saw.

d) The cutting ends of the inside cutters must be staggered.

e) When the dado head is assembled on the arbor, the witness marks on the saws and on the inside cutters should be placed on top of the arbor as shown in Figure 23.

C. The dado head is designed for:

1. Cutting grooves in well-seasoned lumber only.
2. Smooth cutting when properly sharpened.
3. A wide variety of grooving where speed is not the chief essential.

D. Range of widths of grooves possible:

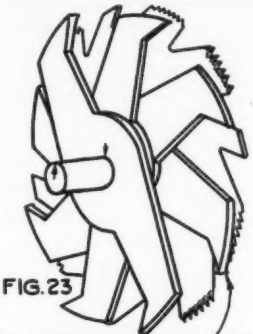

FIG. 23

THE CUTTING ARRIS OF THE INSIDE CUTTER NEXT TO A GROOVER SAW MUST BE OPPOSITE A GULLET ON THE SAW

DADO HEAD WITH ONE GROOVER SAW REMOVED TO SHOW RELATIVE POSITION OF INSIDE CUTTERS WHEN MOUNTED ON THE ARBOR. NOTE THE WITNESS MARKS ON THE CUTTER AND THE ARBOR

1. One-eighth-inch grooves with single thin groover saw.
2. One-quarter-inch grooves with two thin groover saws together.
3. Five-sixteenth-inch grooves up to grooves of any width, by variations of 1/16 in., may be made at one cut by using a sufficient number of inside cutters.
4. Grooves of any intermediate widths may be made at one cut by placing thin washers of paper or of sheet metal between the inside cutters.

E. Care and operation of the dado head:

1. The dado head must be maintained perfectly round, viz., all of the cutting points must be the same distance from the center of the arbor. This is possible only when both saws and all of the inside cutters are marked with witness marks to indicate the relative position of each on the arbor. When for any reason the dado head must be sharpened, the entire head — both of the saws and all of the inside cutters — should be assembled on the arbor and the entire head jointed with a coarse-grit, medium-hard carborundum stone, and all points brought to the same cutting circle. The filing must be carefully done to avoid making any of the points more than 1/64 in. short.
2. The groover saws and the inside cutters must be kept free from pitch and gum. Whenever the dado head, in any combination of cutters, is mounted on the arbor, all saws and cutters should be wiped clean before being placed on the arbor. This is essential for smooth and accurate grooving. The presence of pitch or gum on the sides of the cutters may cause the dado head to wabble slightly and to make a groove wider than the assembled head actually measures.
3. The "set-up" should be tested with a scrap of wood each time the dado head is mounted on the arbor to avoid needless errors.
4. *Warning:* The groover saws that belong to a dado head should never be used singly to do cutting that can be done with a hollow-ground saw; if one of the saws is dulled, the

(Continued on page 100)

Automotive Equipment, Tools, and Supplies

Teachers and supervisors may find these maximum lists helpful in checking their inventories or preparing their budgets.

Name and Description	No.	Name and Description	No.
Air Compressor		*Creepers*	
3 to 4 cu. ft., with tank, piping, and motor		*Desk with Chair*	
Small portable, 1 cu. ft., with motor		*Drill*	
Aligning Jig, for connecting rods		Breast	
Anvil		Hand	
No. 100 or No. 125		Electric portable, ½-in.	
Rim		Electric portable, ¼-in.	
Armature Growler and Tester		Press, 21-in., with motor and chuck	
Axle Stands		*Dynamometer,* electric	
Battery Equipment		*Forge,* with blower and tools	
Cell tester, panel type with discharge rack		*Furnaces,* gas	
Charger (15-battery size) with rack		*Grease Dispensers*	
Charger (6-battery size)		*Grinder*	
Gas stove (small)		Cylinder with motor	
Lead-burning torches, with gauges and piping		8-in., with motor	
Plate racks		12-in., with motor	
Bench		*Hones,* cylinder	
Electric test, elaborate		*Jacks*	
Electric test, simple		Lever, 1½ ton	
Work, with vises		Floor, roller	
Work, portable with vise		*Lathe*	
Blackboard		11 in. by 4 ft. with motor, chucks, and attachments	
Blowtorches, 1 quart		16 in. by 6 ft. with motor, chucks, and attachments	
Bookcase		*Press*	
Brake		*Arbor*	
Adjusting stand		30 ton	
Band-lining machine		*Spray Painting Outfit*	
Bulletin Board		*Valve Refacing Machine*	
Cabinets		*Vulcanizer*	
Wood or metal, for bolts and supplies		Electric steam for tube work	
Wood or metal, for filing job sheets and correspondence		Small, hand	
Chain Hoist, with overhead trolley and track		*Welding Outfit,* with tanks, gauges, and cutting torch	
Chairs with Tablet Arms, or chairs for tables		*Wheel Alignment*	
Crane, portable		Gauge	
Crankshaft Truing Tool		Test table	

Small Tools

Name and Description	No.	Name and Description	No.	Name and Description	No.
Alcohol Tester		1-gal. gas safety		*Floor Brushes,* 18 in.	
Battery		5-gal. gas safety		*Funnels,* tin, assorted sizes	
Cell tester, prod type		5-gal. kerosene		*Gauges*	
Cell tester, cadmium		Waste can		Air pressure	
Clips, large		*Checks,* tool, 1,000 blank		Center	
Element pullers		*Chisels*		Depth	
Fillers		Cape, 3/8- and 5/8-in., each		Thread	
Funnels, glass		Cold, 3/8-, 5/8-, ¾-, 1-in., each		Thickness	
Hydrometer, acid		Diamond point each		*Glass Cutters*	
Knives		*Combination Squares,* 12 in.		*Goggles*	
Post builders		*Cotter-Pin Extractor*		*Grease Guns,* plain and pressure-type, each	
Post drills		*Dividers,* 6 and 10 in., each		*Hammers*	
Post reamers		*Drill Sets*		Ball-peen, 4-oz.	
Post markers		1/32 to ½ in. by 64ths		Ball-peen, 1¼-lb.	
Separator trimmer		½ to 1¼ in. by 32nds		Ball-peen, 2-lb.	
Bits		*File Cards*		Lead	
Expansive		*File Handles,* assorted		Riveting	
Ratchet brace		*Files*		Sledge, No. 12	
Wood, 3/16 to 1 in., sets		Flat bastard, 6, 8, 10, and 12 in., each		*Ladle*	
Bolt Cutter		Half round, 6, 8, 10, and 12 in., each		3-in. bowl	
24 in.		Mill, 6, 8, 10, and 12 in., each		6-in. bowl	
36 in.		Round, 6, 8, 10, and 12 in., each		*Lamps,* extension, with reels	
Calipers		Square, 8, 10, and 12 in., each		*Lead Pot,* gas	
6 in., inside		*Fire Extinguishers,* Pyrene and Acid		*Magnet Charger*	
6 in., outside		*First-Aid Cabinet and Supplies*		*Meters,* volt and ammeter test, each	
Cans					
Oil, 1/3 pint					

(Continued on page 90)

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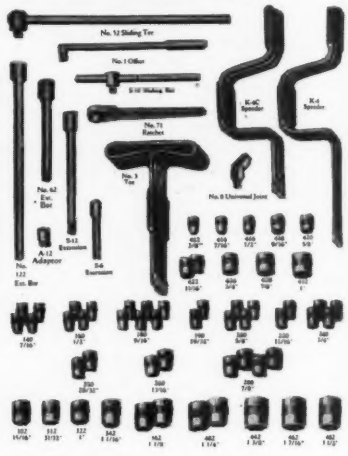

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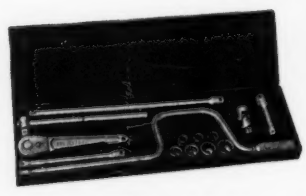

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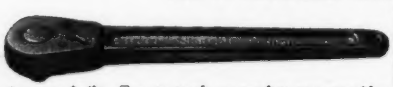
8 sizes of Drain Plug Sockets that save much time and bother. Fit Master Handles.

No. 71 Reversible Ratchet



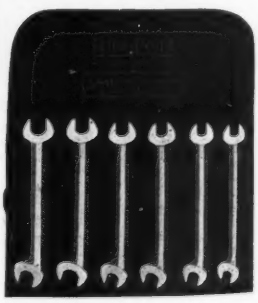
Ratchet action reverses instantly by moving a convenient thumb lever. Designed to be the strongest and most practical tool of its kind and size ever built. Twenty teeth on ratchet gear provides turning action in the closest quarters with only a slight handle movement. Wheel and pawl accurately machined from finest high-carbon alloy tool steel.

Tappet Wrenches

Scientific and balanced design, better steel, lighter weight and thinner heads. A 1934 development that puts Blue-Point "Supreme" Tappet Wrenches in a class by themselves. Built for professional work, they embody every advanced feature in construction, material and workmanship. BT-8 Set, 7/16" to 7/8" sizes.

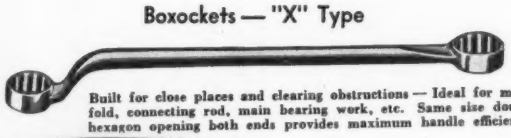
Open End Wrenches

BPR-8 Set Blue-Point "Supremes." Five outstanding improvements:—Thinner head design—Narrower jaws for close corners—Lighter Weight—Better, tougher steel — Distinctive modern design and finish. 3/8" to 7/8" sizes.

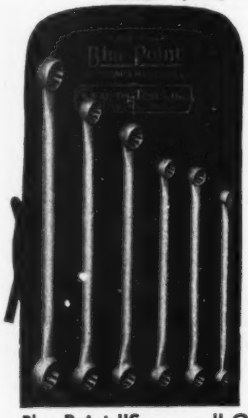


Snap-On Tools, Inc.—Continued

Boxockets — "X" Type



Built for close places and clearing obstructions — Ideal for manifold, connecting rod, main bearing work, etc. Same size double hexagon opening both ends provides maximum handle efficiency.



"XD" Type

Straight-handle Boxocket Wrenches with heads set at a 15° angle — provides obstruction clearance and retains long leverage and direct pulling power. Different size each end. XD-6 Set, 12 sizes, 7/16" to 1".

Dwarf Boxockets

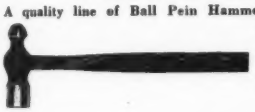
Each end offset to clear obstructions and two sizes on each handle. Made in several popular and needed sizes. Handy for carburetor, universal joint, generator, manifold work and other close quarter jobs.

Blue-Point "Supreme" Chisels and Punches

Professional use demands a chisel that will cut bolts, cast iron and steel without damage to the cutting edge, yet tough enough for use as a wedge or lever. Blue-Point "Supreme" Steel contains these and other properties not found in other makes of Chisels or Punches. Above all, the danger of flying chips is entirely eliminated. See catalog for various types and sizes.

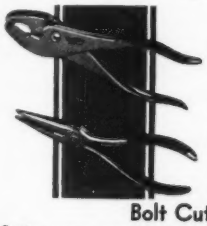
Hammers and Screw Drivers

A quality line of Ball Pein Hammers, correctly designed and balanced, with handles of selected seasoned hickory. Heads securely anchored. Made in 12 sizes.



Blue-Point "Insuloid" Screw Driver shown is one of the most popular units. Blade designed to withstand hardest service—handle insulated composition. See catalog for descriptions of this and other types.

Vacuum Grip Pliers



Famous among mechanics for their high quality, strength and durability. Cut at left shows No. 137 Heavy Duty General Use Plier and No. 196 Needle Nose Plier. No. 109 Packing Nut Wrench shown above turns any shaped nut, rod, bolt, etc. Grips like a pipe wrench. Many other plier types shown in catalog.

Bolt Cutter and Nut Splitter

Cutting power exceeds that of any other bolt cutter of similar size on the market. Handles hammer forged—will not bend or snap. Four types of Cutting Blades and a Nut Splitter Blade interchangeable on one handle.

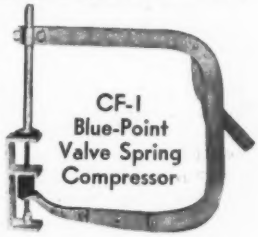
Ford, Chevy and Buick Tools

Special purpose tools designed to simplify difficult jobs on these cars are too numerous to describe here — write for catalog.

Valve Grinder

Sturdily built and smooth in operation. Machined gears. Rapid oscillating motion. A real tool for long hard service.

No. 310 Feeler Gauge
Finest Swedish Steel



Stronger, slim adjustable jaws for all types of motors. Cam lock holds spring compressed. Easy to use—simple to adjust.

Blue-Point Wire Brushes

Made to outlast any similar tool on the market. High quality selected crimped wire, metal bound to prevent bending and dangerous chips from breaking loose. Hand brush fitted with scraper blade, replaceable head.

Wheel and Gear Pullers

No. 200 Blue-Point Universal Wheel Puller and interchangeable Collets services practically all makes and models of cars. Nothing to adjust—simply screw in proper collet and attach to wheel hub. Makes wheel pulling easy. Other types for grooved and un-threaded hubs available. See catalog.

Blue-Point Gear, Bearing Race and Universal Pullers are essential units in every shop. Take all bearings and races, pinion and axle shafts, timing gears, bushings, retainers, flanges, etc. Descriptions in catalog.

Tool Budget Plan

With the information obtained through a careful survey of school shop requirements we have prepared fourteen distinct Tool Lists or Budgets ranging in price from $25.00 to $250.00 and containing the most useful selection of tools obtainable for any given amount of money. These Budgets, however, are simply suggested sets for average shops and we are glad to make up special selections to suit particular shop requirements.

A representative from our nearest branch office would be glad to assist you in making such selection and to give you complete information regarding the Snap-On School Shop Budget Plan and special discounts. There is no obligation on your part and we invite you to ask for this helpful, friendly service.

Write for this New Catalog

Space here only allows us to show a small number of the standard and none of the special tools in the Snap-On and Blue-Point lines. There are literally hundreds of other dependable, high quality units, just as important, illustrated and fully described in our regular catalog, a copy of which we are anxious to send you together with detailed Budgets. It places you under no obligation and we suggest you write for them immediately.

Genuine Snap-On Wrenches and Blue-Point Tools can be purchased only through our own Sales Branches listed. Advise your Purchasing Department accordingly.

Albany, N. Y..... 102 Quail St.
Atlanta, Ga..... 79 Edgewood Ave. S.E.
Baltimore, Md.....2218 Greenmount Ave.
Boston, Mass..... 510 Cambridge St., Allston Dist.
Brooklyn, N. Y.....1649 Bedford Ave.
Buffalo, N. Y..... 952 W. Ferry St.
Chicago, Ill..... 2025 MichiganBlvd.
Cincinnati, Ohio.....2512 Gilbert Ave.
Cleveland, Ohio.....2438 Euclid Ave.
Columbus, Ohio..... 107 N. Monroe Ave.
Dallas, Texas.....2809-11 Main St.
Denver, Colo..... 17 E. Fourth Ave.
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Indianapolis, Ind..... 933 N. Illinois St.
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Newark, N. J..... 429 Central Ave.
New York, N. Y..... 7 Lenox Ave.
Omaha, Neb.....2041 Harney St.
Philadelphia, Pa.....1705 Fairmount Ave.
Pittsburgh, Pa.....7250 Kelly Blvd.
Richmond, Va..... 603 W. Broad St.
San Francisco, Calif.. 276 Golden Gate Ave.
Seattle, Wash..... 110 Broadway, N.
St. Louis, Mo.....2647 Washington Blvd.
Syracuse, N. Y..... 111 W. Taylor St.
Toledo, Ohio.....1012 Jackson St.
Toronto, Ont..... 54 Dundas St., West
Vancouver, B. C.....1152 Howe St.

Export Department, Snap-On Tools, Inc.,
59-61 Pearl St., New York, N. Y.

SNAP-ON TOOLS - -

Factory and Main Office
KENOSHA, WISCONSIN

(Continued from page 88)

Name and Description	*No.*
Micrometers	
Outside, 0 to 1 in.	
Outside, 2 to 3 in.	
Outside, 3 to 4 in.	
Inside, 1½ to 6 in.	
Molds	
Battery nut	
Battery post	
Battery strap	
Burning stick	
Lead hammer	
Oilstone	
Pipe Taps, ⅛, ¼, ⅜, and ½ in.	
Pliers	
Combination, 6 in.	
Flat nose	
Round nose	
Pullers	
Bearing	
Gear	
Wheel, hub type	
Punches	
Center (sets)	
Taper pin (sets)	
Blacksmith (sets)	
Putty Knives	
Reamer, spindle bolt	
Reamer Sets	
Piston pin, ½ to 1⅜ in.	
Taper pin	
Valve seat, sets	
Saws	
Hack, frames, 10-in., adjustable	
Hack-saw blades, 18-, 20-, and 24-teeth	
Hand	
Scales	
Steel, 6-in., graduated 1/64 and 1/100 in.	
Steel, 12 in., graduated 1/32 in.	
Scrapers	
Bearing, sets	
Carbon, sets	
Screw Drivers	
6 in.	
12 in.	
Small Combination	
Screw Extractors, sets	
Scribers	
Snips, tin, 3-in. straight and 3-in. curved, each	
Soldering Coppers, 1-, 2-, and 3-lb. with handles, sets	
Spring Spreaders	
Stamps	
Figures, 3/16-in., set	
Letters, 3/16-in., set	
Tap-and-Die Sets	
Machine screw	
S.A.E. ¼ to 1 in.	
U.S.S. ¼ to 1 in.	
Tire Tools, sets	
Tool Kit, metal box or canvas roll, empty	
Twist Drills (extra sets), selected sizes	
Valve	
Grinders (hand)	
Spring lifters	
Wrenches	
Adjustable, 18-in.	
Adjustable, 12-in.	
Adjustable, 10-in.	
Adjustable, 8-in.	
Ignition sets	
Pipe, 10-, 14-, 16-, and 18-in., each	
Rim socket	
Socket sets, large assortment with case	
Spark plug	
Speed wrenches	
Standard end sets, ¼ in. to ⅞ in., U.S.S. and S.A.E.	
Valve-tappet wrenches, sets	

Supplies

Name and Description	No.
Acetylene Gas, in drums, for welding	
Acid	
Alcohol, gal.	
Babbitt, lb.	
Bearing Blue, tubes	
Bearing Compound, cans	
Bolts	
Machine, selected sizes, lots of 100 each	
S.A.E., selected sizes, lots of 100 each	
Stove, flat or round heads, selected sizes, in lots of 100 each	
Brake Juice, ½-pt. cans	
Brushes	
Paint	
Spark-plug	
Spoke	
Steel	
Varnish	
Chamois	
Coil-Spring Assortment	
Copper Tubing	
Cotter Pins, assorted sizes, pkgs.	
Crocus Cloth, quires	
Distilled Water, gal.	
Drain Cocks	
Electrolyte, carboy	
Emery Cloth, Nos. 00, 0, ½, and 1, quires each	
Enamel for Auto Painting	
Gaskets	
Copper asbestos	
Cork and felt	
Flange	
Gasoline	
Grease, cup, cans	
Kerosene	
Keys, Whitney, assorted	
Lacquer, colors, qt.	
Lead	
Lubricant, transmission	
Nails and Brads	
Nuts	
S.A.E., castellated, square, hexagon. Selected sizes and kinds, lots of 100 each	
U.S.S., square and hexagon. Selected sizes, lots of 100 each	
Machine-screw, selected sizes, in lots of 100 each	
Wing, selected sizes, in lots of 100 each	
Oil	
Cylinder, light, medium, and heavy	
600W	
Penetrating, pints	
Oxygen in drums for lead burning	
Pig Lead, lb.	
Piston-Ring Compressors	
Radiator Hose	
Rivets, brake-lining, 5/16, ½, and ¾ in. long. Boxes of 100, each	
Sandpaper, Nos. 00, 0, ½, and 1, quires each	
Screws	
Flat-head or round-head, iron or brass. Selected sizes and kinds, per gross, each	
Cap and machine, iron or brass. Selected sizes and kinds, lots of 100 each	
Sealing Compound	
Shellac, ½-pt. cans	
Shim Stock	
Soapstone, lb.	
Solder, bar, wire, or self-fluxing wire	
Soldering Paste	
Spelter, for brazing, lb.	
Sponges, ½-lb. each	
Starting Cable, ft.	
Tacks and Staples, for upholstery	
Tire	
Carcass fabric	
Cushion stock	
Inner-tube repair stock	
Patching cement	
Patches	
Putty	
Tread stock	
Vulcanizing	
Valve-Grinding Compound, coarse and fine, 8-oz. cans	
Washers	
Lock, assorted sizes	
Wrought iron	
Waste, lb.	
Wire	
Primary, ft.	
Secondary, ft.	

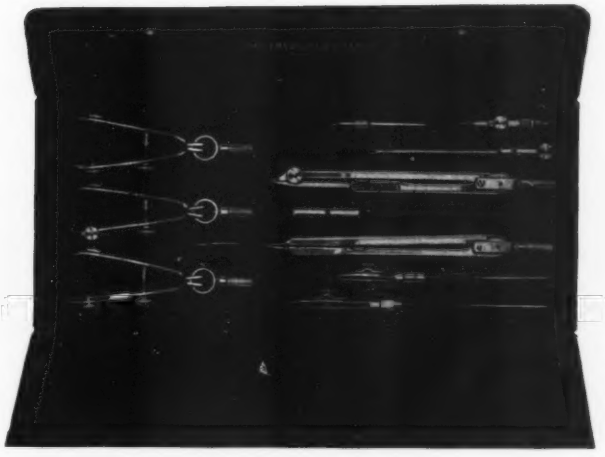
Typical of POST Value - -

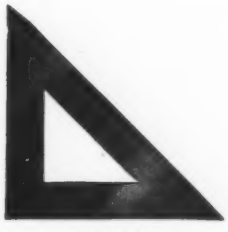
COMPLETE OUTFIT NUMBER ONE

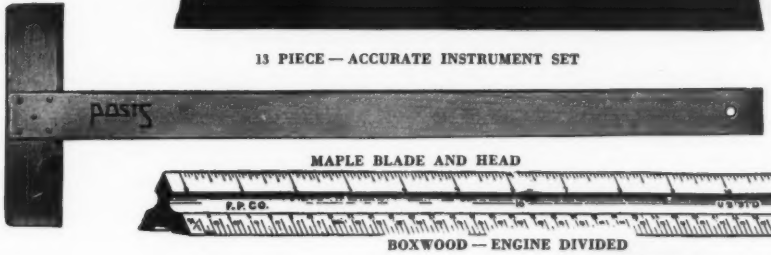
LIST PRICE
$13.00

$7.80
TO SCHOOLS

CELLULOID 10"


13 PIECE — ACCURATE INSTRUMENT SET

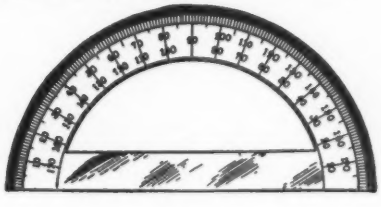

CELLULOID 8"


MAPLE BLADE AND HEAD

CELLULOID

BOXWOOD — ENGINE DIVIDED

BASSWOOD



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4½" Ruling Pen } both with } Bow Divider 3½" Bow Pen 3½".
5½" Ruling Pen } releases } Bow Pencil 3½" Plain Divider 5½".
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The merchandise in this outfit is fully guaranteed against defects in workmanship and material.

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Electrical-Shop Equipment, Supplies, and Motor and Testing Equipment

Teachers and supervisors may find these maximum lists helpful in checking their inventories or preparing their budgets.

Name and Description	No.
Bench Grinder	
Benches	
Plain or with drawers, for tools and equipment, or with compartments for the storing of wiring panels. Preferably they should have electrical outlets	
Bits	
Auger, ¼" to 1" by 16ths, each	
Auger, ¼". 18" long	
Drill, for wood, square shank, ⅛" to ½", by 16ths, each	
Expansion	
Extensions, 18"	
Screw-driver, ¼"	
Blackboard	
Permanent or portable	
Blowtorches, 1-qt. size	
Bookcase	
For reference books, catalogs, etc.	
Braces, ratchet-type, 8" swing	
Bulletin Board	
Cabinets	
Wood or metal, for filing class records, instruction sheets, drawings, etc.	
Chairs	
Tablet-arm chairs	
Compass Saw	
Coil	
Spreader	
Taper	
Winder	
Desk	
Teacher's, with drawer compartments	
Chair, to match desk	
Drill	
Breast	
Concrete, ⅜", ½", ¾", 1", each	
Hand	
Portable Electric	
Twist, 3/32" to ⅜" by 32nds, each	
Drill Press	
Bench, hand or power driven	
Heavy, power driven	
Files	
First-Aid Cabinet and Supplies	
Hack Saw	
Blades, 10", 24 teeth per inch. Gross	
Frames, adjustable	
Hammers	
Claw, 12 oz	
Machinists', ball-peen	
Hickey, ½" and ¾", each	
Lathe	
Engine, 10" or 12" swing, 6' or 8' long	
Speed	
Pliers	
Gas, 6½"	
Gas, 8"	
Side-cutting, 6"	
Punches, assorted, sets	
Punch, for metal molding	
Reamers	
Pipe burring, ¼" to 1"	
Pipe burring, ½" to 2"	
Rules	
48" zigzag	
72" zigzag	
Screw Drivers	
3"	
5"	
8"	
Shears, for cutting metal molding	
Soldering Coppers, assorted	
Soldering Copper, electric	
Soldering-Copper Handles	
Solder Dippers	
Stocks and Dies, for pipe threads, ½" to 1"	
Vises	
Machinists', 4"	
Pipe	
Wrenches	
Adjustable, 6"	
Adjustable, 8"	
Pipe, 10", 12", and 14", each	
Socket, combination, sets	

ELECTRICAL SHOP—SUPPLIES

Name and Description	No.
Armored Cable	
2-wire, No. 14, single-strip, ft.	
3-wire, No. 14, single-strip, ft.	
Box connectors	
Attachment Plug	
Battery Acid, 1.300 carboy	
Batteries, dry cells	
Battery-Sealing Compound, lb.	
Bar Hangers	
Box Cleats	
Brads, ¾", No. 19, and 1½", No. 16, lb. each	
Brake Lining, ¼"x 2" ft.	
Brushes, carbon, for motors and generators	
Burglar Contacts	
Open-circuit	
Closed-circuit	
Bushings	
Loom, No. 1 and No. 2, each	
"Jiffy" loom No. 2	
Buzzers	
Cleats, unglazed porcelain, 2-wire	
Clips, test, with insulators, Universal, Nos. 22, 23, 24, and 25. Each	
Commutator Cement, cans	
Conduit	
Bushings, ½", ¾", and 1" each	
Box connectors, for flexible. Couplings, for flexible	
Lock nuts, ½", ¾", and 1" each	
Rigid, ½", ¾", and 1", ft. each	
Condulet	
Fillings, ½", LL, LR, and LB, each	
Covers, ½", blank	
Door Openers, mortised	
Emery Cloth, 1½" wide, rolls	
Fixtures, brass-chain, suspension	
Fixture Studs	
Fish Paper, .0125" thick, sq. yd.	
Fuses	
Plug-type, renewable, 125-volt, 15 amp	
Cartridge-type, renewable, 125-volt, 30 amp	
Renewals for plug fuses	
Renewals for cartridge fuses	
Ground Clamps, ⅜" to 1", assorted	
Hickey Grips, ½" and ¾", each	
Lamps	
Carbon, 220-volt, 60 watt	
Mazda, 10-watt, type B, 120-volt	
Guards, for brass sockets	
Leather Nail Heads	
Lugs, 25 and 50 amp	
Lumber, 2"x 4"x 14', No. 1, white pine, dressed 4 sides, pc.	
Molding	
Metal, ft.	
Metal, fittings—crosses, tees, internal elbows, junction boxes, switch bases, keyless receptacles, snap switches. Each	
Wood, 2-wire, with capping, ft.	
Wood, 3-wire, with capping, ft.	
Nails, roofing, lb.	
Nuts, iron, 4-36, 6-32, 8-32, 10-24, 12-24, 10-32, 14-20, gross each	
Outlet Boxes, 4" square, with one round blank cover, and one cover with bushed opening, each	
Pipe Straps, galvanized, ⅜", ½", ¾", and 1". lb. each	
Push Buttons	
Return-call, 3-point	
Single-piece	
Receptacles	
Flush, duplex	
Porcelain - cleat, 660 - watt, 250-volt	
Concealed	
Covers	
Resistance Units, 125-ohm	
Rosettes, wood	

(Continued on page 94)

General Electric Company

General Offices: Schenectady, N. Y.

Sales Offices: Address Nearest Office

Akron, Ohio, 106 S. Main St.
Atlanta, Ga., 187 Spring St. N.W.
Baltimore, Md., 39 W. Lexington St.
Binghamton, N. Y., 19 Chenango St.
Birmingham, Ala., 600 N. 18th St.
Boston, Mass., 140 Federal St.
Buffalo, N. Y., 1 West Genessee St.
Butte, Mont., 20 W. Granite St.
Cedar Rapids, Ia., 203 Second St., S.E.
Charleston, W. Va., 304 Capitol St.
Charlotte, N. C., 200 S. Tryon St.
Chicago, Ill., 230 S. Clark St.
Cincinnati, Ohio, 215 W. Third St.
Cleveland, Ohio, 4966 Woodland Ave.
Columbus, Ohio, 40 S. Third St.
Dallas, Texas, 1801 N. Lamar St.
Davenport, Ia., 511 Pershing Ave.
Dayton, Ohio, 25 N. Main St.
Denver, Colo., 650 Seventeenth St.
Des Moines, Ia., 418 W. Sixth Ave.
Detroit, Mich., 700 Antoinette St.
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Erie, Pa., 10 E. Twelfth St.
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Fort Worth, Tex., 408 W. Seventh St.
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Jacksonville, Fla., 700 E. Union St.
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New York, N. Y., 570 Lexington Ave.
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Oklahoma City, Okla., 119 N. Robinson St.
Omaha, Nebr., 409 S. 17th St.
Philadelphia, Pa., 1405 Locust St.
Phoenix, Ariz., 441 W. Madison St.
Pine Bluff, Ark., 501 Main St.
Pittsburgh, Pa., 535 Smithfield St.
Portland, Ore., 621 S. W. Alder St.
Providence, R. I., 76 Westminster St.
Richmond, Va., 700 E. Franklin St.
Rochester, N. Y., 89 East Ave.
St. Louis, Mo., 112 N. Fourth St.
Salt Lake City, Utah, 200 S. Main St.
San Antonio, Tex., 201 Villita St.
San Francisco, Calif., 235 Montgomery St.
Schenectady, N. Y., 1 River Rd.
Seattle, Wash., 821 Second Ave.
Spokane, Wash., 421 Riverside Ave.
Springfield, Ill., 607 E. Adams St.
Springfield, Mass., 116 Liberty St.
Syracuse, N. Y., 113 S. Salina St.
Tacoma, Wash., 1019 Pacific Ave.
Toledo, Ohio, 405 Madison Ave.
Trenton, N. J., 143 East State St.
Tulsa, Okla., 409 S. Boston St.
Utica, N. Y., 258 Genessee St.
Washington, D. C., 806 15th St., N.W.
Waterbury, Conn., 72 W. Liberty St.
Wichita, Kans., 116 So. Main St.
Worcester, Mass., 165 Commercial St.
Youngstown, Ohio, 25 E. Broadman St.

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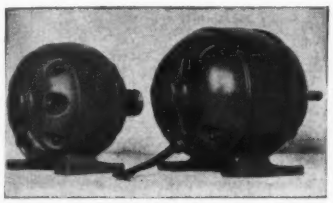
Motor Dealers and Lamp Agencies in all large cities and towns

Shop Projects

The General Electric Company, in carrying out its elaborate educational program, has sponsored the preparation and publication of several construction projects for technical and vocational schools. These projects are exceptionally valuable for the school shop due to the fact that they are not merely assembly projects but involve a certain amount of mechanical dexterity with such tools as the lathe, drill press, tap and die, etc. The projects already issued and available without charge cover:



Educational Projects. ¼ H.P. and ¾ H.P. Motors.

1) ¼ H.P. Single-Phase, 60 cycle, 110 volt motor Bulletin GED-379
2) ¾ H.P. 3-Phase, 60 cycle, 110 volt motor Bulletin GED-534
3) ½ kw. 220–110/55 volt, single-phase, air-cooled transformer Bulletin GET-128

Kits for these projects can be purchased from the General Electric Company. In addition, complete instructions are given for the s curing of any equipment that may not be included in the kit. Address your request to the Educational Specialist at the nearest General Electric Sales Office.

G-E Educational Service

The General Electric Company is deeply interested in education, as it recognizes that the future welfare of industry, and of the country as a whole, depends upon how well the students of today are trained for the work of tomorrow. It is the policy of the Company to aid the faculty and students of our schools and colleges in every way possible. To this end, Company publications, motion-picture films, illustrated lectures, etc., are made generally available without charge.

General Electric engineers will be glad to recommend apparatus to meet your special conditions if you will give them details such as: Type of course, number of students, laboratory or shop space available. money at hand for equipment, etc. Further than this, liberal discounts from the regular commercial prices of Company products are allowed to educational institutions. For quotations on apparatus and further information concerning G-E educational service, consult the Educational Specialist at the nearest office of the Company.

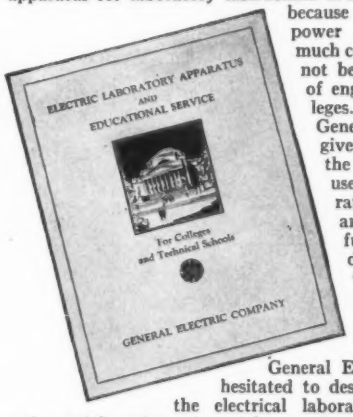
Illustrated Lecture Service

General Electric Motion Pictures are available without charge to educational institutions. They are particularly valuable to schools and colleges. as they enable the student and teacher to keep informed on all important developments in the electrical field.

Complete information on this service is available in publication GES-402B.

Shop Equipment

In general the General Electric Company recommends standard apparatus for laboratory instruction. It is recognized, however, that because of its size, cost, and the power required for operation, much commercial apparatus cannot be used in the laboratories of engineering schools and colleges. For this reason, the General Electric Company has given especial attention to the selection for educational use of such standard apparatus as is of suitable size and which will illustrate fundamental principles of design and construction as well as acceptable commercial practice.



Where standard apparatus is not suitable, the General Electric Company has not hesitated to design special apparatus for the electrical laboratory and shop. Among such special equipment may be mentioned the switchboards both for engineering and physics laboratories, special industrial control panels for A-C. and D-C. service, the AHI synchronous motor (or generator), and the 5 kw. rotary converter.

Thus the student is given an opportunity, while becoming familiar with the underlying principles of electrical engineering, to become acquainted with actual construction details. Bulletin GEA-1185A, which has been recently revised, illustrates and describes G-E apparatus particularly adapted for laboratory use.

Selection of Equipment for Electrical Shop and Laboratory

When deciding on the equipment for an electrical shop or laboratory, Bulletin GEB-62A will be particularly useful. In this booklet will be found listed in six different groups, equipment to meet a wide range of requirements. For the elementary courses a few of the more important types of machines are recommended, together with control apparatus, measuring instruments, and certain machine tools which should be in every electrical shop. For more advanced work, or as funds become available, equipment from other groups may be added to provide well balanced laboratory equipment which will permit a particularly wide range of experiments.

In addition to listing the equipment, this booklet discusses briefly the several items, explaining why they have been selected and the use to which they may be put in the laboratory.

Electrical Shop Layout

Where special conditions make standard laboratory or shop layouts unsuitable, General Electric engineers will be pleased to prepare for you without charge a laboratory or shop layout that will insure the most economical use of space and money. If you have any special electrical problems you are invited to consult with our engineers.

(Continued from page 92)

Name and Description	No.	Name and Description	No.	Name and Description	No.
Screws		**Solder Wire,** 50/50, size No. 10, lb.		Rubber, ½-lb. rolls	
Anchors, 8/32, 10/24, 12/24, 14/20, each		**Soldering Paste,** 2-oz. cans, noncorrosive		**Tubes**	
Machine, round-head, ¼", 4-36; ½", 6-32; ¾", 6-32; ⅜", 8-32; ½", 8-32; 1", 8-32; ⅜", 10-32; ⅜", 10-24; ¾", 10-24; ¾", 10-32; 1", 12-24; gross each size		**Soldering Salts,** 1-oz. cans, noncorrosive		Porcelain, ⅜"x 3"	
Machine, brass, round-head, ¼", 4-36; ½", 6-32; ¾", 6-32; ½", 8-32; gross each size		**Split Knobs,** porcelain		Porcelain, ⅜"x 5"	
Wood, flat-head bright, ¾" No. 5, ½" No. 8, ¾" No. 8, 1" No. 7, 1½" No. 8, 1½" No. 10, 2" No. 7, gross each size		**Switch**		Porcelain, ⅜"x 10"	
Wood, round-head blued, 1" No. 7, 1½" No. 8, 1½" No. 10, 2" No. 7, gross each size		Battery, 4-point		**Tubing**	
Sleeving, No. 1, white, No. 1, blue, and No. 1, red. Spools each		Bases, porcelain for 10-amp. switches,		Flexible nonmetallic, ¼", ft.	
Sockets, brushed brass		Boxes, 2¾" deep		Flexible nonmetallic, ⅜", ft.	
Pull-chain		Entrance, safety, 2-pole, 30-amp., with 2-branch lighting circuits		**Washers**	
Keyless		Entrance, safety, 3-pole, 30-amp., 250-volt		Iron, ¼" and ⅜", lb. each	
Key		Flush, push-button, S.P., D.P., 3-way, 4-way, each		Brass, ¼" and ⅜", lb. each	
Socket Caps, ¼" brushed, ⅜" bushed, each		Surface, S1		**Wire**	
Porcelain keyless, with caps		Surface, S3		Annunciator No. 18 or No. 20, lb.	
		Surface, S4		Fixture, No. 18, single yellow, with marker, ft.	
		Knife, type A, D.P.S.T., D.P.D.T., S.P.S.T., and S.P.D.T., each		Fixture, No. 18, single yellow, with marker, ft.	
		Surface, snap, electrolier		Rubber covered, solid copper, No. 10, black, ft.	
		Surface, snap, S.P.D.P., 3-way, 4-way, each		No. 10, white, ft.	
		Tacks, double-pointed No. 10, lb.		No. 14, black, ft.	
		Tape		No. 14, white, ft.	
		Friction, ½-lb. rolls		Rubber covered, No. 16, brewery cord, ft.	
				No. 18, lamp cord, green and yellow, ft.	
				S.C.C. copper magnet, enameled, sizes, Nos. 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, lb., each	

Electrical Shop—Motor and Testing Equipment

Name and Description	No.	Name and Description	No.	Name and Description	No.
Annunciators		volt, a.c.		ing from 1 to 12, 6- and 12-volt batteries	
Automatic needle-drop		Voltmeter, standard, 125-volt, d.c.		**Relays,** Dixie	
Gravity-drop		Voltmeter, student, 110-volt, d.c.		**Resistance Boards,** for testing.	
Manual needle-drop		Voltmeter, student, 110-volt, a.c.		**Rheostats**	
Armatures, burnt-out, for repairing		Wattmeter, standard, 110-220-volt, 30-60-amp., d.c.-a.c.		Compression, 275-watt	
Battery Charger, commercial.		Wattmeter, student, 110-220-volt, 30-amp., a.c.-d.c.		Field, for shunt and compound motors	
Circuit Breakers		Watt-hour Meter, 125-volt, 5 amp., a.c., single-phase, various makes		**Rotary Converter,** 5-kw. capacity, 3-phase, a.c., 110-volt d.c.	
Air, single-pole, overload, 25-amp., 550-volt		**Motors**		**Speed Counters,** 0-9999	
Air, single-pole, underload, 15-amp., 550-volt		Auto starter, different makes		**Spring Balances,** 0-30 lb.	
Controllers		Burnt-out, fractional h.p., 110-volt, 60 cycle, for repairing		**Starting Boxes**	
For multiple-speed motor		Compound, 1 h.p., 110-volt, d.c.		For compound motors, various makes	
For 1-h.p., 110-volt series motors		Multiple-speed, 1 h.p., 3-phase, 220-volt		For shunt-wound, 1 h.p., 110-volt motors. Overload release	
Generators		Series, 1 h.p., 110-volt, d.c.		For shunt-wound, 1 h.p., 110-volt motors. No voltage release	
Motor-generator set, 10-h.p., to supply 110-volt		Shunt, 1-h.p., 110-volt, d.c.		Starting devices of various makes and principles, for 1 h.p., 3-phase, 220-volt, a.c. motors	
d.c., for testing purposes, battery charging, etc.		Split-phase and repulsive, a.c., 110-volt, single-phase, assorted		**Storage batteries,** 6-volt	
Generator, 6-volt d.c., coupled to an a.c. motor, for 6-volt circuit testing		Split-phase induction motors, fractional h.p., 110-volt, 60-cycle, different makes		**Switchboard,** as required	
Auto generators of different makes		3-phase, 1 h.p., a.c., 220-volt, various makes		**Telegraph Sets,** including sounders, keys, and relays, each	
Gravity Cells		3-phase, 2 h.p., 220-volt, a.c., various makes		**Telephones**	
Magnets, testing, 10,000-ohm		Universal, fractional h.p., 110-volt, different makes		Complete bridging, independent phones	
Meters		Universal, variable-speed, ½ h.p.		Couch vestibule telephones	
Ammeter, standard, 60-amp., a.c.		**Platform Scale,** 100-lb. capacity		Receivers, transmitters, induction coils, condensers, and bridging switch hooks, each	
Ammeter, standard, 60-amp., d.c.		**Rectifiers,** Tungars, for charg-		**Transformers**	
Ammeter, student, 60-amp., a.c.				Bell-ringing, 6-8-14-volt	
Ammeter, student, 60-amp., d.c.				Single-phase, 110-220-volt, S. K.V.A.	
Voltmeter, standard, 0-10-volt, d.c.					
Voltmeter, standard, 110-220-volt, d.c.-a.c.					
Voltmeter, standard, 125-					

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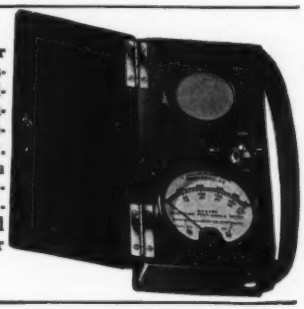
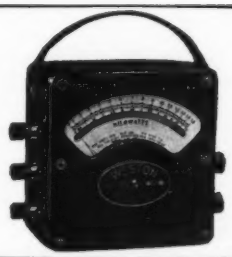


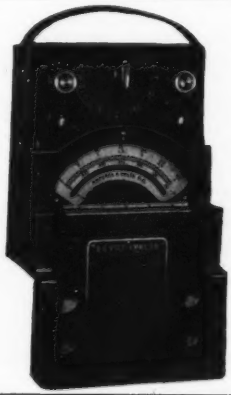
Foot-Candle Meter—Model 614 measures light intensities directly in foot-candles. Completely self-contained. Easy to use as a Voltmeter. "Human-error" eliminated. A practical instrument for schools.

Photronic Cell—Model 594, dry type—simple in design—a marked advance in light sensitive cells. Current output about 1.4 microamperes per foot-candle. Unlimited life. Uses no battery, no amplifier.



"Junior" Line—Portable A.C. Ammeters and Voltmeters for general testing on commercial frequencies. Movable iron type. Accuracy within ½ of 1%.

Model 45—Portable D.C. Ammeters and Voltmeters. Permanent magnet movable coil type, for general testing. Shielded from the effects of external magnetic fields. Accuracy within ½ of 1%.



Model 540—Ideal miniature portable 6-range D.C. Volt-ammeter. Cannot "burn-out." Independent replaceable fuses protect each of the three current and three potential ranges. Compact Bakelite case. Mirror scale. Range changing switch. Precision type pocket size instrument. Reasonably priced.

Give students that feeling of confidence which comes from using Weston Instruments. Give yourself the satisfaction of purchasing instruments which are recognized the world over as standards of accuracy—a truly sound investment, combining long life and minimized servicing as Westons do.

Weston is continually pioneering in the art, developing new instruments to meet the ever changing conditions. Outstanding among the recent contributions is the Weston Photronic Cell.

This photo-electric cell is of an advanced type. It is radically different in design, simpler, and reduces the cost of application, primarily because it is a miniature power plant which converts light energy into electrical energy. No outside source of potential is needed to operate instruments or relays.

Throughout the Weston line, from this new Photronic Cell to the widely used miniature 3¼" instruments, exacting standards of craftsmanship prevail. The reliable performance resulting from Weston precision manufacture teaches a valuable lesson to the student of science. For this reason, Weston Instruments are the preferred equipment in schools and colleges.

There is a Weston instrument for every electrical testing requirement. Write for your copy of latest catalog, containing descriptive information and prices of the hundreds of models—many range combinations. Weston Electrical Instrument Corporation, 595 Frelinghuysen Avenue, Newark, New Jersey.

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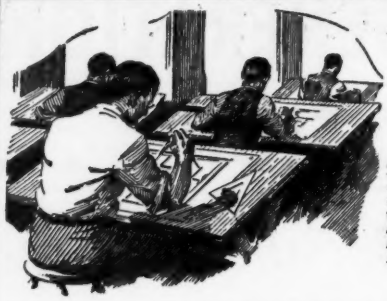


The Pease "Junior" Blue-Printing Machine is equipped with the famous Pease Type "P" High Power Arc Lamp.

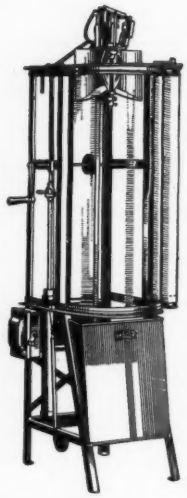
Why Not Make Your Own Blue Prints?

MODERNIZE YOUR SCHOOL DRAFTING ROOM

The Pease "Junior" Blue-Printing Machine and Sheet Washer is a Special School Model Blue-Printing Equipment . . . initial investment is small . . . operating expense is maintained at a minimum.

The Pease "Junior" Equipment has real class room value and you can teach students the "Art Of Making Blue-Prints" right along with their studies and at the same time turn out first-class reproductions of daily school bulletins, charts, diagrams, etc., at low cost, for every other department in the school.

Perfect Blue-Prints, Negatives, Blue Line and Brown Line Prints can be made at a moment's notice at any time, regardless of weather conditions, and students actually serve an apprenticeship on this standard, commercial type equipment.

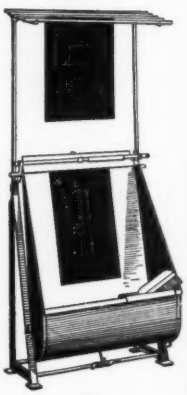


The Pease "Junior" Blue-Printing Machine

The "Junior" Blue-Printing Machine can be plugged directly into the lighting circuit and will operate on either 110 or 220 volts A. C. or D. C. It will handle prints of any size up to 24 x 36".

The "Junior" Sheet Washer is equipped with both spray pipe and drain pipe, thus completely eliminating open trays of water, dripping prints, and wet floors. Floor space is small and the complete equipment can be stood in a corner of the drafting room.

Write today for facts and prices on the "Junior" Equipment AND BE SURE to ask for special FREE booklet entitled "Instructions for Making Blue-Prints."



The Pease "Junior" Sheet Washer

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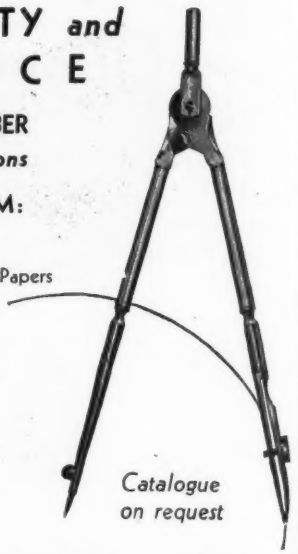

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GENERAL MECHANICAL DRAWING

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in your junior-high-school classes

THE BRUCE PUBLISHING CO., Milwaukee, Wis.

Drafting Equipment and Supplies

Teachers and supervisors may find these maximum lists helpful in checking their inventories or preparing their budgets.

Name and Description	No.	Name and Description	No.	Name and Description	No.
Adjustable-Curve Ruler		**Drawing-Board Supports, to be set on or attached to wood-worker's bench**		**Steel Scales, 12"**.....	
Beam Compass		**Drawing Tables and Stools**		**Stop Watch,** for mechanical-drafting students.....	
Bench Brushes		For students.....		**Table**	
Blackboards		For teacher.....		For cutting and trimming drawings and blue prints.	
Compass, 15", with locking device		**Ink-Bottle Holder**.....		For disassembling and reassembling machine parts and models	
Drawing set: T square straightedge, triangle, and protractor		**Irregular Curves,** Nos. 17, 21, and 24, wood, rubber, or transparent, each		**Tapeline**	
Permanent or portable.....		**Lettering Angles**		100' steel, for architectural students	
Blue-Print		**Lettering Pens,** assortment of 12		50', steel or metallic.....	
Frame or machine.....		**Level or Transit,** builders', for architectural students		**Tool Box,** containing 1 machinist's hammer, one 6" adjustable wrench, one 6" screw driver, one pr. 6" combination pliers	
Washing trays or washer...		**Leveling Rod,** for use with the transit		**Triangles**	
Paper tube, air-tight.....		**Machinists' Combination Set,** 12"		30-60-deg. 14" transparent...	
Drying Rack or Dryer.....		**Marking Pins,** for use with measuring tape, for architectural students.....		45-deg. 10" transparent.....	
Bookcase, for reference library		**Micrometer,** 1", for mechanical-drafting students		**Triangular Scales,** civil engineers' type, 12".....	
Cabinet		**Oilstone,** 3" case.....		**T Square**	
For filing drawings.....		**Pantograph,** 21".....		Adjustable or fixed head, for large drawing board, or straightedge with parallel rule attachment for large drawing boards.....	
For storing drawing boards.		**Parallel Rules**.....		**Wall Charts,** lettering, decimal equivalents, etc., each.....	
For storing drawing instruments		**Planimeters.**		**Yardstick**	
For storing models.....		**Plumb Bob**			
Calipers		**Shears,** for trimming blue prints and drawings.....			
6" inside and outside, each..		**Speed Counter,** for mechanical-drafting students			
8" inside and outside, each..					
Desk					
Teacher's					
Chair to match.....					
Dividers, proportional.....					
Drafting machine and accessories					
Draftsman's Steel Protractor..					
Drawing Boards, large.....					

Drafting—Small Equipment

To be provided by, or for, each student

Drawing Board, size to be specified by the instructor..		**Pencil Compass**		**Slide Rule,** 10", as specified by the instructor.....	
Drawing Instruments, as specified by the instructor, sets..		**Penholder,** for lettering pens..		**T Square,** to fit drawing board	
Erasing Shield		**Pens,** assorted, for lettering...		**Triangles**	
Irregular Curve, Nos. 8 and 13, transparent, each		**Protractor,** not over 5".....		30—60-deg., 10" transparent.	
		Scale, 12" architect's, triangular		45-deg., 8" transparent.....	
		Scale Guard.....			

Drafting Supplies

Bichromate of Potash, crystals, lb.		Cross-section, 8½"x11", reams		**Powder,** for tracing cloth, cans	
Blue-Print		Detail, 24"x36", reams.....		**Tracing Cloth,** 36", yd.....	
Paper, 36" wide, yd.....		Drawing, 24"x36", reams....		**Van Dyke**	
Writing fluid, bottles.....		Isometric, 7"x10", sheets....		Fixing salts, 4-oz. cans.....	
Paper		Tracing, 36", yd.....		Paper, 36", yd.....	
				Writing fluid, 2-oz. bottles..	

Drafting—Additional Supplies

To be provided by, or for, each student

Erasers		**Ink**		**Pencils,** drawing, HB, 2H, 3H, 4H, and 6H, each.....	
Cleaning		Black, waterproof, ¼-oz., bottles		**Pencil-Pointer Pad**.....	
Ink		Colored, if required, ¼-oz., bottles of each color.....		**Thumb Tacks**	
Pencil					

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Manufacturers of

Drafting Instruments and Supplies

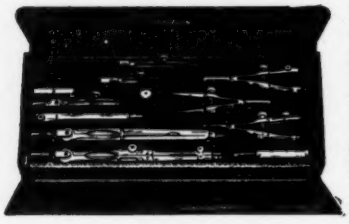
We have ten grades of drawing instruments—a grade for every purpose and purse. The top grades of our drawing instruments are the finest instruments obtainable, and are universally standard among the professional trade. Our school grades, the four most popular of which are listed below, are standard in practically every school in the country and are universally the choice among instructors who pride themselves on equipping their students with the best sets obtainable for the money expended. Each of our grades of instruments is put up in different size sets. Below you will find what we term complete six and seven piece sets. You will note that they are of two styles—the square or trigonal type and the flat, round type. The type of instrument is always a matter of individual choice.

It might be well to mention that all Dietzgen Instruments are made exclusively in Dietzgen Factories and are standardized. The parts in each grade are interchangeable. These parts are listed in our catalog, which affords complete replacement and repair part service at your finger tips.

We have arranged complete repair parts of the popular grades into repair kits. These kits will service about 50 instruments of one grade. Repairs can be made immediately, thus eliminating the inconvenience of having instruments lying around for repair, and holding work up.

"Federal" Drawing Instruments

An excellent quality, square American type, instrument. Substantially made of dense rolled nickel silver and steel, carefully finished. Compasses and Dividers equipped with differential straightening device. Compasses and Bow Instruments fitted with screw-thread needle points. Ruling Pen and Pen part of Compasses have slide-catch cleaning devices. Furnished in Pocket Case lined with Silk Velvet.



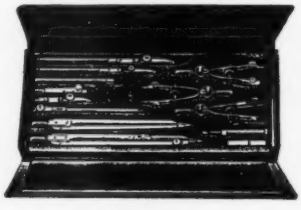
No. 1047

No. 1047 contains 5 and 5½-in. spring blade Ruling Pens; 3½-in. side-screw Bow Dividers, Bow Pencil, Bow Pen; 6-in. hair spring adjustable Dividers; 6-in. Compasses with Pencil part, Pen part, and Lengthening Bar; Center Tack; Combination Screw Driver and Lead Box; Box with extra needle points.

No. 1046. Same as No. 1047, but without the 5-in. Ruling Pen.

"Universal" Drawing Instruments

A good quality, flat round type instrument. Made of rolled nickel silver and steel, nicely finished. Compasses and Dividers equipped with straightening device. Compasses and Bow Instruments fitted with adjustable and reversible needle points; Ruling Pens and Pen part of Compasses equipped with slide-catch Cleaning device. Furnished in Pocket Case lined with Silk Velvet.



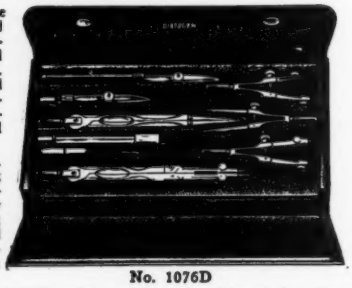
No. 1057C

No. 1057C contains 5 and 5½-in. spring blade Ruling Pens; 3¾-in. center screw Bow Dividers, Bow Pencil, Bow Pen; 6-in. hair spring adjustable Divider; 6-in. Compasses with Pencil part, Pen part, Divider part, Lengthening Bar, and extra metal handle for use with Pencil and Pen parts of Compasses; Screw Driver and Lead Box; Box with extra needle points.

No. 1057. Same as No. 1057C, but Bow Instruments have side wheel.
No. 1056C. Same as No. 1057C, but without 5-in. Ruling Pen.
No. 1056. Same as No. 1056C, but Bow Instruments have side wheel.

"Scholar" Drawing Instruments

A square American type instrument, made of rolled nickel silver and steel. Compass and Dividers equipped with straightening device. Compasses and Bow Pencil have reversible and replaceable needle points. Furnished in Pocket Case lined with velvet.



No. 1076D

No. 1076D contains 5½-in. spring blade Ruling Pen; 3½-in. side-screw Bow Dividers, Bow Pencil, Bow Pen; 6-in. plain Dividers; 6-in. Compasses with Pencil part, Pen part, and Lengthening Bar; Key; Lead Box with extra leads.

No. 1077D. Same as No. 1076D, with addition of a 5-in. Ruling Pen.

"Prep" Drawing Instruments

A flat round type instrument made of nickel silver and steel. Compass and Dividers equipped with straightening device. Compasses and Dividers and Bow Instruments have reversible and replaceable needle points. Furnished in Pocket Case lined with Velvet.

No. 1087S

No. 1087S contains 5 and 5½-in. spring blade Ruling Pens; 3¾-in. side-screw Bow Dividers, Bow Pencil, Bow Pen; 6-in. plain Divider; 6-in. Compasses with Divider part, Pencil part, Pen part, Lengthening Bar, and extra metal handle for use with Pencil and Pen parts; Combination Screw Driver and Lead Box.

No. 1086S. Same as No. 1087S, but without the 5-in. Ruling Pen.

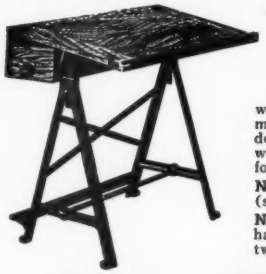
"Sheffield" Drawing Tables

"Sheffield" Drawing Tables are rigid and durable, and well adapted for drafting rooms in technical schools. They are 38 in. high and have a selected, well-seasoned white pinewood top and drawer furnished with lock and key.

No. 4434-6. Sheffield Drawing Table, with drawer 10½x25x3¾", with board 31x43".

No. 4435-7. Like No. 4434-6, but with drawer 37x25x2", with board 37x49".

"Madison" Drawing Tables



"Madison" Adjustable Drawing Tables are designed to meet all the requirements of an efficient and durable table for the classroom. They are of solid iron construction, with hardwood top, and are so arranged that they may be used, alternately, by two students, each table having two drawers with locks, for storing tools, and a shelf for holding drawing boards.

No. 4448. Madison Drawing Stand (stand only).

No. 4450. Madison Drawing Stand with hardwood top 25x32", with shelf and two drawers with locks.

"Ideal" Adjustable Drawing Tables

"Ideal" Adjustable Drawing Tables are strong, durable and rigid. They are made of hardwood, with well-seasoned pinewood tops, and are especially adapted for use in schools.

No. 4440-6. Ideal Drawing Table, with board 31x43".

No. 4441-7. Like No. 4440-6, but with board 37x49".

"Sturdy" Drawing Tables

"Sturdy" Drawing Tables are designed to meet the demand for a strong, sturdy, comparatively inexpensive drawing table. They are made of thoroughly seasoned hardwood with a selected white pinewood top, and are 34 inches high.

No. 4479B. Sturdy Drawing Table, Adjustable Top 36x72", with 6 file drawers 37¾x25x2", and 2 tool drawers 17¾x25x3¾", with 3-inch raising blocks.

Eugene Dietzgen Co.—Continued

Dietzgen Drawing Materials

We exercise a careful diligence in maintaining our reputation for quality, service and fair prices. Our special school prices appeal to all instructors.

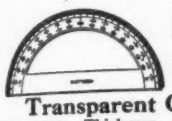
Triangular Scales

No. 1626

U. S. Standard, machine divided, selected seasoned material, deep cut lines, fine finish.

No. 1626. Architects, mechanical engineers triangular boxwood scale; 12 in. open divided: 1/8, 1/4, 1/2, 3/4, 1, 1 1/2, 3 in. to the foot, 1/2 in. ..... Each,
No. 31626. Like No. 1626, but of hardwood ..... Doz.,
No. 1636. Civil Engineers triangular boxwood scale; 12 in. divided: 10, 20, 30, 40, 50, 60 parts to the in. ... Each,
No. 31636. Like No. 1636, but of hardwood ..... Doz.,

Brass Protractors



Semi-Circular Brass Protractors divided in degrees both ways.

No. 1935L. 3 1/2 in., with scale on bottom, Each,
No. 1935R. 4 1/2 in., Each,

Transparent Celluloid Curves and Triangles

No. 2014. Thickness, .06", 30x60°, Plain, Size 4, 6, 8, 10, 12 inches.
No. 2015. Thickness, .06", 45°, Plain, Size 3, 4, 6, 8, 10, 12 inches.

Accurately made, nicely finished. Seasoned material. Retain their transparency and trueness, and will give years of satisfactory service for accurate work.

No. 2014 No. 2015

Sizes 13 and 15 Style No. 2152

Dietzgen Drawing Ink

The ink flows freely, dries quickly, contains no grit or acid, and is absolutely uniform. Universally used among artists and professional draftsmen, and in leading schools, colleges and universities.

No. 2681. Black and 10 fast brilliant colors. In 1/4 Oz., 4 Oz., 1/2 Pt., Pt., and Qt. Bottles.

Pencil Pointers

No. 3213. 12 sheets, 1 1/4 x4 in., Sand Paper, with handle.
No. 3220. 12 sheets, 1 1/4 x4 in., Emery Paper, with handle.

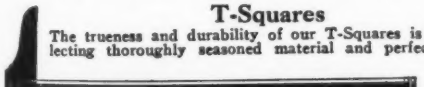
Stamped Steel Thumb Tacks

Made of best quality, nickel-plated hard steel, needle finish point, put 100 in a box or a dozen in a box.

No. 2440. 3/16 in., Box of 100. No. 2445B. 3/8 in., Box of 1 Doz.
No. 2441. 1/4 in., Box of 100. No. 2446B. 1/2 in., Box of 1 Doz.
No. 2442. 1/2 in., Box of 100. No. 2447B. 1/2 in., Box of 1 Doz.

T-Squares

The trueness and durability of our T-Squares is obtained by selecting thoroughly seasoned material and perfect workmanship.



No. 2077

No. 2060. Maple Blade and Head, Fixed Head, Sizes 18, 21, 24, 30, 36 in. ..... Each,
No. 2077. Transparent Celluloid lined Blade, Fixed Head, Sizes 18, 24, 30, 36, 42 in. ..... Each,

Drawing Boards

No. 4406. Made of strips of selected white wood. Two drawing surfaces and end cleats. Sizes 16x22, 18x24, 20x24 1/2, 20x26, 23x31 in.

No. 4410. Made of strips of selected, well-seasoned white pine wood joined together by tongue and groove. Two drawing surfaces and end cleats. Sizes 16x22, 18x24, 20x24 1/2, 20x26, 23x31 in.

Mechanical Drawing Paper

Size 19x24, per quire or ream.

No. 9 White, slightly grained surface, strong, excellent erasing qualities, a perfect pencil paper, as well as for ink or color work.
No. 9A. Same as No. 9, but smooth surface.
No. 10. White, a good school drawing paper, slightly grained surface.
No. 11. Light cream, slightly grained surface, strong, stands erasing well, takes ink, pencil or color.
No. 11A. Light cream, Thick, High grade, slightly grained surface, excellent erasing qualities. Takes pencil, ink, or color.

We have special discounts for Schools and Institutions. Write us your requirements and let us send you an estimate of cost.

Blue Printing Equipment

Without Blue Printing equipment in the classrooms, both instructors and students are hampered. Mechanical drawing students are unable to see the reproduction value of their efforts unless they themselves make prints. Shop students are unable to secure thorough experience in working from blue prints. Instructors cannot fully impress students with the real purpose of mechanical drawing . . . which is to make drawings from which prints are made for the shop or building foreman's guidance.

Dietzgen Junior Vertical Electric Printing Machine

Will print clear, sharp, distinct prints fast and with great economy. The print is uniformly exposed over its full area. The Junior has the same sturdy construction, the same type of Speed Regulator and Automatic Cut-off which have made the Dietzgen Senior so satisfactory. The machine has a half cylinder of glass with an open printing surface of 24x36 inches; glass is held in a felt lined metal frame.

Roller Curtain — The tracing and sensitized paper are held in place by Roller Curtains. Rollers hold curtain at uniform tautness over the entire surface of the glass.

Hi-Power Arc Lamp—The specially designed Hi-Power Arc Lamp gives off an intense light, rich in printing qualities. It consumes 12 amp. on 110 or 220 volts, 60 cycle, A.C., and 25 amp. on 110 and 220 volts, D.C. An aluminum reflector insures the best possible distribution of light.

Speed Regulator — An improved pneumatic Speed Regulator insures uniform speed in the descent of the lamp. It is noiseless in operation, absolute in its regulation, and provides for a wide range of speed.

Automatic Cut-off — Automatically extinguishes the light at any desired point. This permits machine to be loaded, set in operation, and left unattended, without possibility of prints becoming over-exposed.

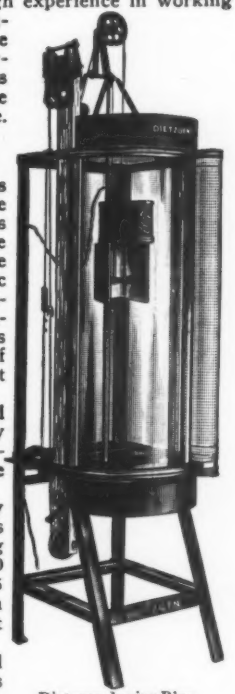
No. 4334-1A — Height, 83 inches. Occupies 18x22-inch floor space. Finish, beautiful brown enamel frame. Printing surface sheets 24x36 in. or smaller, complete with Lamp No. 4348-1A, 12 amp. lamp for 110 volt, 60 cycle, A.C.

No. 4334-1D — Like No. 4334-1A, but with 25 amp. lamp No. 4348-2A for 110 volt, D.C.

No. 4334-2A — Like 4334-1A, but with 12 amp. lamp No. 4348-2A for 220 volt, 60 cycle, A.C.

No. 4334-2D — Like No. 4334-1A, but with 25 amp. lamp No. 4348-2D for 220 volt, D.C.

When ordering, state voltage and whether current is direct or alternating.



Dietzgen Junior Blue Printing Unit Illustrated. No. 4334-I Vertical Electric Printing Machine, above. No. 4310A Junior Sheet Washer, below.

Dietzgen Junior Sheet Washer

This washer, especially designed for use with the Dietzgen Junior blue printing machine, thoroughly washes and develops blue prints and negative prints in sheets.

No. 4310A—For prints 24x36 inches or smaller, floor space 24x32 inches, with tray 28 inches wide. Complete with chemical tray and brush. Many unusual and excellent features.

To Save Your Needed Time

This booklet, the "Use and Care of Drawing Instruments," covers thoroughly the details of this subject. Available to Instructors gratis for distribution at the beginning of the semester. Give us the number of students anticipated, and the beginning date of next semester, and we will send you that quantity in proper time.

NEW IDEAS

LEND CLASSROOM INTEREST AND ENTHUSIASM TO MECHANICAL DRAWING

A YEAR or so ago, Chas. M. Higgins & Co., Inc., made the suggestion to mechanical drawing teachers that student imagination and enthusiasm could be stimulated by interpreting the subject in interesting terms of today's industry.

Under the supervision of a nationally recognized authority, J. H. Constantine, Director of Industrial Education, Passaic, N. J., Public Schools, this suggestion was tangibly presented in the Higgins' Award Contest last year, with the hope that it would assist the teacher as an additional classroom incentive.

The response was gratifying—another such contest was held this year as a result. This contest closes March 15—there is still time for you to write for the interesting "Romance of Industry" brochure for classroom distribution and study, and for the contest details. USE THE COUPON BELOW.

For Best Results
BE SURE TO SPECIFY
HIGGINS' AMERICAN DRAWING INKS
The Standard Since 1880

BLACKS

GENERAL (SOLUBLE) WATERPROOF

COLORS

ALL WATERPROOF

CARMINE	INDIGO	ORANGE
BRICK-RED	BLUE	VERMILION
GREEN	VIOLET	SCARLET
BROWN	YELLOW	NEUTRAL TINT

WHITE (OPAQUE)

HIGGINS'
American
DRAWING INKS

CHAS. M. HIGGINS & CO., INC.,
271 NINTH ST., BROOKLYN, N. Y.

Kindly send me, without obligation, a copy of your "Romance of Industry" project sheets and outline of the Higgins' Award Contest.

NAME.....

MAIL ADDRESS.....

SCHOOL.....

(Continued from page 86)

entire dado head must be mounted on the arbor and jointed, and then filed. Even though the groover saws cut smoothly and are designed to do any cutting that may be done with the hollow-ground saws, it is most unwise to use them for this purpose; for if one saw of the set is dulled, all of the inside cutters as well as the two saws must be jointed down to the same cutting diameter and filed.

Questions for Thought and Discussion

1. What is a dado head?
2. What is the purpose of the dado head?
3. Describe the Huther dado head.
4. What widths of groove may be made at one cut?
5. How is it possible to make grooves of different widths with but one dado head?
6. Why should the sides of the different members of the dado head be kept clean and free from pitch and gum?
7. Why is it essential that the cutting points of the inside cutters just next to the saw shall be placed opposite the gullets of the saws?
8. Why is it poor practice to use the outside dado saws independently for ripping or crosscutting?

HOMEMADE PAINT SPRAYER

John H. Dillon, Indiana State Teachers' College, Terre Haute, Indiana

The accompanying illustration shows a paint-spraying outfit that was built by the writer from parts picked up around a junk yard, with a few additional new parts. This outfit is being used and is proving very popular with a large number of shop teachers in this school. The outfit is small, compact, and portable. It can handle any spray job from small pieces of furniture to enameling a car or painting a room. Lacquers, shellac, stains, paints, and enamels can be sprayed on much faster and more evenly than they can be applied with a brush. For such work as wicker, art fiber, radiators, trellises, etc., this outfit is far superior to a brush.

The cost is so small in comparison with the returns that any shop can well afford a similar outfit. The air gun alone, is worth its cost as a means of cleaning machinery and engine parts around the shop.

Following is a list of parts and their approximate cost:

¼-h.p. motor (new)	$ 9.45
1 2-in. Pulley (new)	1.00
1 Spray Brush and Hose (new)	8.50
1 Automobile Compressor (old)	2.00
1 Presto-o-Lite Tank (old)	2.00
1 6-in. Pulley (old)	.15
3 ft. 1½-in. Belt (old)	1.00
2 ft. ¼-in. Air Hose (new)	.20
4 6-in. Wagon Wheels (old)	.25
1 piece of ½-in. round soft Steel 16½ in. long	.05
1 piece of ½-in. round soft Steel 13½ in. long	.05
1 piece of ⅛ by ½-in. flat Steel for handle 75 in. long	.15
Wood Body of Wagon (scrap box) 16 by 27 in.	
Wood Bolster for Wagon (white pine) 2 in.	.40
1 4-in. Nipple and 1 in. to ¼-in. Reducer	.25
1 Brass Bar ⅞ by 2 in.	.10
1 Gas Valve (scrap)	.00
Total	$25.55

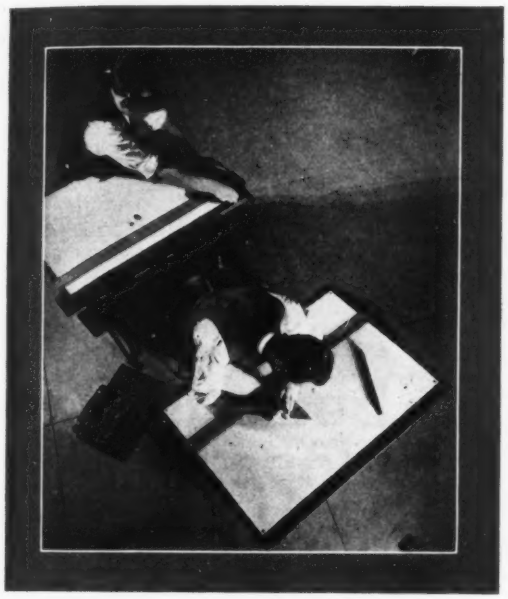
The pressure tank must be cleaned before using. Before starting to clean it, drill a hole in the same end as the gauge, for a 1-in. pipe tap. Loosen the contained material with a pointed rod, then pull out with a bent wire. Tap this hole and screw in a 1-in. pipe nipple. Place the reducer on the end of the nipple and screw the brush hose into the reducer Screw the gas valve in the other end of the tank.

Mount the tank, compressor, and motor on the wagon bed, and connect the compressor with the tank by means of a short air hose; then fasten the hose in place with wire.

(Continued on page 104)

Quicker Handwork

KEENER HEADWORK!



SUSTAINED interest and keen enthusiasm for any subject are gratifying alike to instructor and supervisor. With MECHANICAL DRAWING this is particularly true—but "good tools" *must* be provided to attain and maintain this much-to-be-desired standard of study.

There IS a difference in mechanical drawing instruments. It *will* be reflected in better student work. Precision instruments, perfectly balanced, sharp and serviceable give the student a feeling of confidence and surety that make for real enthusiasm and appreciation for mechanical drawing.

Since 1860 KEUFFEL & ESSER CO. has made a careful study of school requirements in mechanical drawing materials that has resulted in the development of special types of instruments, slide rules and supplies for this particular work—priced to permit liberal buying of the complete assortments so essential to the proper teaching of the subject.

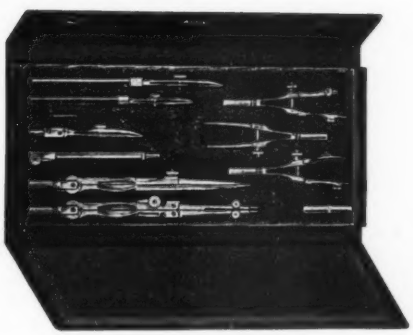
This unusual line is fully described in the latest K & E catalog for High Schools. Every mechanical drawing teacher and supervisor should have a copy. Write for yours NOW and for best results in the future be sure to

SPECIFY

KEUFFEL & ESSER

DRAWING MATERIALS AND SLIDE RULES

- *Drawing Materials*
- *Slide Rules*
- *Surveying Instruments*
- *Measuring Tapes*



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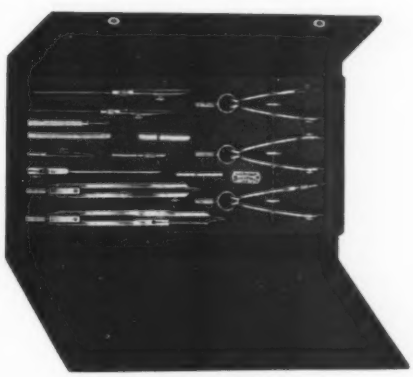
TRADE MARK)



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KEUFFEL & ESSER CO.
Hoboken, N. J.

NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO MONTREAL

KEUFFEL & ESSER CO.,
300 Adams St., Hoboken, N. J.
Kindly send me (check material desired)

☐ Your 12-page booklet, "Drafting Materials—Their Care and Use";
☐ Your "Elementary Instructions for Operating the Slide Rule"; and
☐ Your catalog "Drawing Materials for High Schools".

Name .....

Address .....

School .....

Western States Envelope Co.

1616 West Pierce St., Milwaukee, Wis. **Long Distance Phone Orchard 9310**

Manufacturers of

Felt Brush Gummed Envelopes

We are closely affiliated with the printing trade, and through years of study have been enabled to work with and help solve the envelope requirements of modern business.

All of this experience is available to school print shop instructors. The envelope requirements of modern business have become so varied that it is important that every boy entering Industry be properly informed.

What We Are—What We Make What We Do

THE WESTERN STATES ENVELOPE COMPANY was organized May, 1908, with one idea in mind, namely — that of operating an envelope factory that would do as printers would do if they were running it themselves.

We have done as much for you or even more than you would have done for yourselves had you been in our place; in fact, it can truthfully be said at this time that we are "YOUR ENVELOPE MANUFACTURER." Operating your Envelope Service Station.

Our first business is to plan and develop the envelope business in the interests of the printer and lithographer.

WE ARE EMPHATICALLY INDEPENDENT IN EVERY WAY.

WE MAKE all the regular sizes of commercial and official envelopes, from six to fourteen, including the special flaps of which we have over thirty-nine different styles. See Trade Circular No. 2.

Envelope Trade Names and Sizes

6¼ Commercial	3½x 6	10 Official	4⅛x 9½
6¾ Commercial	3⅝x 6½	11 Official	4½x10⅜
7 Official	3¾x 6¾	12 Official	4¾x11
7½ Two-fold	3⅛x 7½	14 Official	5 x11½
9 Official	3⅞x 8⅞	6¾ Reverse Face	3⅝x 6½

Included in our complete line of envelopes are a full range of Look-In, Window, Bankers Flap, Catalog, Coin, Collection, Baronial Catalog, Report Card, or any other kind of envelope you may possibly want. We also make special envelopes of all sizes and kinds from any paper.

In addition we carry a complete line of die-cut cards for all purposes in kid, plate, and linen finishes. Our visiting cards may be furnished plain or panelled. Our line of wedding and announcement stock is very complete. Also round corner cards in white and colors suitable for tickets, meal checks, etc. Write for samples and prices.

A Print Shop Project

Why not have your school print shop print all of the envelopes for your school, or for that matter, for your entire school system? We have every variety of size and grade available. We shall be pleased to furnish the paper and layouts for flat printing or just layouts for you to print on stock which you may have on hand, we to make the envelopes up after you are through printing. We have worked out this service particularly well and shall be pleased to coöperate with you in this way. The "Guide Book" described in the next column should have a place in your school print shop, as it is very instructive. Do not fail to send for it.

Guide Book through Envelope Land

Write for This Informative Envelope Book

This book contains the following bonafide Trade Information

Page 59 gives the number of envelopes out of almost any size of paper.

Pages 55, 56, 57, and 58 give prices for making envelopes from furnished stock, plain or printed.

Pages 61, 62, 63, and 64 give illustrations of different types and styles of envelopes.

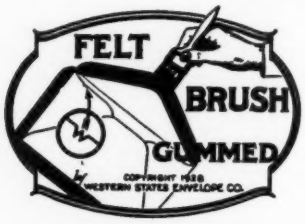
Pages 52, 53, and 54 list unusual envelope papers not regularly carried in stock.

All the above is yours for the asking without any obligation.

Supplying envelope requirements for school systems is our specialty. We will gladly assist in making up your specifications, and will submit bids at any time, on any numbers of envelopes desired.

Envelopes are in stock for immediate shipment, in all grades of stock which include a numerous variety and quality of bonds and krafts.

Western States Felt Brush Gummed Envelopes



A New Type Envelope
which is guaranteed to eliminate gumming and envelope printing difficulties.

By this method the gum is brushed into the pores of the paper and on to the sealing portion of the flap. The flap is larger in size than usual which in addition to other advantages assures good sealing even with hard sized papers.

Felt brush gumming has been in use over two years and has been found very satisfactory. The presence of lumpy gum under the printing side the sealing flap has been eliminated and the tendency to dish, wrinkle or warp has been largely done away with. The design of the sealing flap is also new, and one that shortens make-ready time when printing envelopes.

Felt brush gummed envelopes are also scored before folding, thus assuring square envelopes that pack tightly and consequently occupy less space.

Western States Envelope Co., 1616 West Pierce St., Milwaukee, Wis.

Printshop Equipment and Supplies

Teachers and supervisors may find these maximum lists helpful in checking their inventories or preparing their budgets.

Name and Description	No.	Name and Description	No.
Bellows		*Ink Fountains*	
Hand, small-size		Short, for 8 by 12 press	
Electric, blower-type		Short, for 10 by 15 press	
Blackboard, permanent or portable		Long, for 10 by 15 press	
Bookcase, for reference books, catalogs, etc., sectional preferable		Short, for 12 by 18 press	
Brayer, 6- or 8-in., for proofing		Long, for 12 by 18 press	
Brushes		*Furniture*	
Bench		Iron, 2 by 4 to 10 by 15 picas, fonts	
Benzine, No. 1, oval back		*Galleys*	
Padding, 1½ in. wide		Steel, 8¾ by 13 in.	
Bulletin Board		Steel, 6¼ by 23½ in., double column	
Cabinets		Steel, 12 by 18 in.	
Galley, for double-column galleys, wood or steel, four tiers (to be used with typesetting machines)		*Gauge Pins,* spring-tongue, doz.	
Galley, for 8¾ by 13-in. galleys, wood or steel, four tiers		*Glue Pot,* electric, 1-qt. size	
Ink and Roller, to accommodate platen-press rollers, wood or steel		*Imposing-Tables*	
Matrix, for use with typesetting machines only		12 by 18-in., with iron top, including reglets and furniture	
Roller, cabinet or rack for cylinder rollers		24 by 36-in., with iron top, complete with galley slides, chase rack, reglets, and furniture	
Supply, for leads, slugs, spaces, strip material, with top for lead cutter and mitering machine		36 by 48-in., with iron top, complete with galley slides, chase rack, reglets, and furniture	
Type, school type, each to accommodate two California cases, job cases, case slides, galley slide, and copy holder		39 by 63-in., with iron top, complete drawers, letter boards, reglets, and furniture	
Type, complete with 24 full-sized California job cases, with overhead lead-and-slug cases, wood		*Knives*	
Type, complete with 24 full-sized California job cases, double work bank, wood or steel		Overlay, for make-ready	
Wood or metal, for filing class records, instruction sheets, etc		Ink, 6 in., round end	
Blank, full size, to accommodate ¼-size cases		Ink, 8 in., round end	
Border, ¼ size, for ornamental borders		Ink, 8 in., square end	
Lead and Slug, regular size, to hold labor-saving fonts of leads and slugs		*Leaders*	
Metal Furniture, to hold labor-saving fonts		6-pt. fine dot, lb.	
Rule, ¼ size, for brass rule		8-pt. fine dot, lb.	
Cans		10-pt. fine dot, lb.	
Benzine, pint size		8-pt. hyphen, lb.	
Benzine, 5-gal. size		10-pt. hyphen, lb.	
Kerosene, safety, 1-gal. size		*Leader Boxes*	
Waste Can, fireproof, for rags		*Line Gauges*	
Chairs, tablet-arm		Metal, brass, or steel	
Chases, (for each size of platen press)		Wood, doz.	
For cylinder press		*Metal Furnace,* for recasting and refining type metal, used only with typesetting machines	
Chase Racks		*Mitering Machine*	
For platen presses		*Numbering Machines*	
For cylinder presses		For use on presses	
Composing Sticks		Hand machines	
6 x 2 in., adjustable		*Ornaments*	
8 x 2 in., adjustable		Assorted floral and decorative designs	
12 x 2 in., adjustable		Border, 6-point, decorative, fonts	
18 x 2 in., adjustable		Border, 12-point, decorative, fonts	
Cutter		*Perforator*	
Lead and Rule		24-in., foot treadle	
Paper, lever-type, 20-in., with pedestal. Should handle 20 by 26-in. sheet		28-in., foot treadle	
Paper, lever-type, 26 or 30 in.		*Planer*	
Paper, lever-type, 30-in., with divided back gauge, or 30 to 36-in power cutter		Mallets, hickory or fiber	
Desk		Proof, maple, with felt bottom	
Teachers', with drawer compartments		Type, maple, with leather top	
Chair to match		*Presses*	
Drying Racks		Cylinder, two-revolution, four-roller, 25 by 38, complete with variable-speed motor, cast rollers, etc.	
Combination drying rack and stock table for platen presses, 30 trays		Platen, 8 by 12, with foot treadle, counter, flywheel guard, platen guard, brake and set of cast rollers. (Motor and treadle combination if desired)	
Trays, interlocking, for cylinder press		Platen, 10 by 15, complete with variable-speed motor, counter, flywheel guard, platen guard, brake, and set of cast rollers, etc.	
Folding Bones, (for hand folding)		Platen, 12 by 18, complete with variable-speed motors, counter, flywheel guard, platen guard, brake, and set of cast rollers, etc.	
Folding Machine		Proof, 14 by 18, with cabinet	
20 by 26-in. size, 4-fold, two parallel and two right-angle folds, power		Proof, 20 by 24, with cabinet	
		Punch	
		Foot-power, multiple, with assorted punches	
		Lever, two-die, with assorted punches	

(Continued on page 105)

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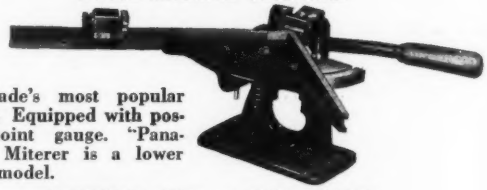

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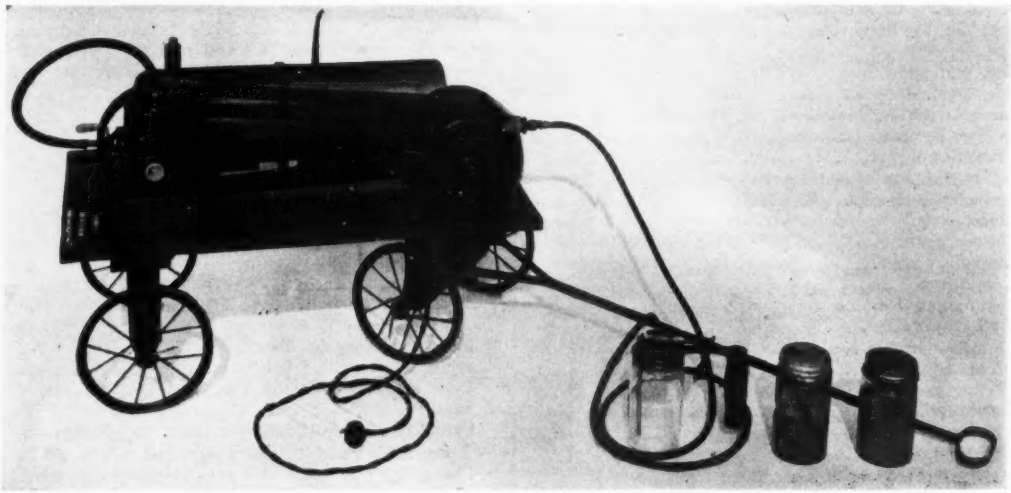
(Continued from page 100)

The safety valve is a piece of 7/8-in. brass rod 2 in. long with a 9/16-in. hole drilled to within 3/8 in. of the bottom. A 1/4-in. hole is drilled the remainder of the way. Threads are tapped from the top about 1 in. down, and a setscrew made to fit. Drill a 1/4-in. hole through the side of the valve 1/2 in. from valve seat. A steel ball that is large enough to cover the 1/4-in. hole is placed in the bottom and a coil spring is set on top of it The setscrew changes the tension on the spring in such a manner that by setting the valve with the gauge, any pressure above a set amount will lift the ball and allows the air to escape.

The axles are drilled for cotter pins and they are then fastened in place. The wheels are mounted between washers and kept in place with the cotter pins. The handle is a piece of 1/8 by 1/2-in. steel 75 in. long. It is fastened to the front bolster as shown in the illustration.



The completed paint sprayer

This spray brush operates best on a pressure of from 40 to 60 pounds. The ordinary automobile compressor will carry as high as 70 to 80 pounds of pressure.

Standard Mason fruit jars are used for the different colors and the only part that needs cleaning is the short fluid pipe. This may be cleaned by drawing a small amount of thinner through the pipe.

(Continued from page 103)

Name and Description	*No.*	*Name and Description*	*No.*
Power, multiple, with assorted punches. (Paper drill may be substituted)		Slugs, labor-saving, 6-point, lb.	
Quoins		Slugs, 2-ft. strips, 6-point, lb.	
No. 1 size, doz.		Spaces and quads	
No. 2 size, doz.		Thin spaces, brass and copper, assorted sizes, 6 to 18 points, one size in each box, sets	
Keys, No. 1 size		*Specimen Display Board*	
Keys, No. 2 size		*Staple Binder*, pedestal-type, foot power	
Rule, plain, brass, (fonts to fit quarter cases)		*Stitcher*, wire, power, capacity ½ or ¾ in., flat and saddle-back tables	
2-point, labor-saving, hair-line, side face, fonts		*Tympan Paper*, (with combination holder and cutter)	
2-point, labor-saving, 1 point side face, fonts		18-in., rolls	
1-point, labor-saving, 1 point face, fonts		38-in., upright, to be used with cylinder press only	
2-point, labor-saving, double face, fonts		*Typesetting Machines*, either linotype or intertype, 2 or 3 magazines, and molds	
Saw Trimmers, pedestal type, with point gauge, and raising and lowering table		Matrices for same, 6, 8, 10, and 12-point, as selected, fonts	
Spacing Material		Tweezers, 3½-in., doz.	
Iron furniture, as selected, fonts			
Leads, labor-saving, 2-point, lb.			
Leads, 2-ft. strips, 2-point, lb.			

Name and Description	*No.*	*Name and Description*	*No.*	*Name and Description*	*No.*
Type		18-point, No. 30, fonts		12-line, fonts	
Body, Lightface—		Job, Light Copperplate Gothic—		15-line, fonts	
8-point, lb.		6-point, No. 1, fonts		18-line, fonts	
10-point, lb.		6-point, No. 2, fonts		10-point, fonts	
Job, Lightface—		6-point, No. 3, fonts		12-point, fonts	
6-point, fonts		6-point, No. 4, fonts		14-point, fonts	
8-point, fonts		12-point, No. 5, fonts		18-point, fonts	
10-point, fonts		12-point, No. 6, fonts		24-point, fonts	
12-point, fonts		12-point, No. 7, fonts		30-point, fonts	
14-point, fonts		12-point, No. 8, fonts		36-point, fonts	
18-point, fonts		Job, Condensed Title Gothic—		48-point, fonts	
24-point, fonts		12-point, fonts		60-point, fonts	
30-point, fonts		18-point, fonts		72-point (caps only), fonts	
36-point, fonts		24-point, fonts		Job, Boldface Italic—	
48-point, fonts		36-point, fonts		8-point, fonts	
Job, Lightface Italics—		48-point, fonts		10-point, fonts	
8-point, fonts		60-point, fonts		12-point, fonts	
10-point, fonts		72-point, fonts		14-point, fonts	
12-point, fonts		Job, Text Type—		18-point, fonts	
14-point, fonts		10-point, fonts		24-point, fonts	
18-point, fonts		12-point, fonts		30-point, fonts	
24-point, fonts		14-point, fonts		36-point, fonts	
36-point, fonts		18-point, fonts		Job, Heavy Copperplate Gothic—	
Job, Boldface—		24-point, fonts		6-point, No. 21, fonts	
6-point, fonts		Job, Typewriter Type—		6-point, No. 22, fonts	
8-point, fonts		12-point, with spaces, lb.		6-point, No. 23, fonts	
12-point, No. 26, fonts		Wood, Condensed Gothic—		6-point, No. 24, fonts	
12-point, No. 27, fonts		8-line, fonts		12-point, No. 25, fonts	
12-point, No. 28, fonts					

Supplies

Name and Description	*No.*	*Name and Description*	*No.*
Benzine or Gasoline, for cleaning type or presses, gal.		Bond, sulphite, 17 by 22 — 16, white, reams	
Bindery Tape, 2 in. wide, brown or black, rolls		Bond, sulphite, 17 by 22 — 16, colors as selected, reams	
Gold Bronze, pale, lb.		Book, enamel, 25 by 38 — 80, white, reams	
Gold Size, lb.		Book, machine finish, 25 by 38 — 80, white, reams	
Ink		Book, eggshell finish, 25 by 38 — 60, white, reams	
Bond, black, for bond papers, lb. cans		Cover, as selected, sheets 20 by 26, medium	
Book, black, for school paper, etc., lb. cans		Card Bristol, fine grade, 22 x 28 — 4 ply, white, sheets	
Cover, colors as selected, lb. cans		Index Bristol, medium grade, 25½ by 30½ — 110, white, sheets	
Cover, colors as selected, ½-lb. tubes		Index Bristol, medium grade, 25½ by 30½ — 140, white, sheets	
Dryers and Compounds, as selected, lb. cans		Mill Bristol, medium grade, 25½ by 30½ — 140, colors as selected, sheets	
Halftone, black, lb. cans		Press Board, red, sheets	
Job, colors as selected, lb. cans		Strawboard, No. 40 or No. 50, bundles	
Job, colors as selected, ½-lb. tubes		Tag Board, manila, 24 by 36 — 140, sheets	
Metallic, gold and silver, lb. cans		Tympan, to fit presses, rolls	
Process, black, red, yellow, blue, lb. cans		Wrapping Paper, size as selected, rolls	
Kerosene, for cleaning rollers, gal.		Holder for same	
Padding Cement		*Twine*, cotton, for tying jobs, lb.	
Cold, gal.		*Wire Stitching*	
Hot, lb.		No. 25 round wire for stitcher, spools	
Paste, Bindery, pints		Wire Staples, ¼ in., for stapling machine, 5,000 in box, boxes	
Make-ready, lb.			
Paper			
Bond, fine grade, 17 by 22 — 16, white, reams			
Bond, medium grade, 17 by 22 — 16, white, reams			

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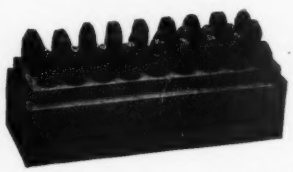

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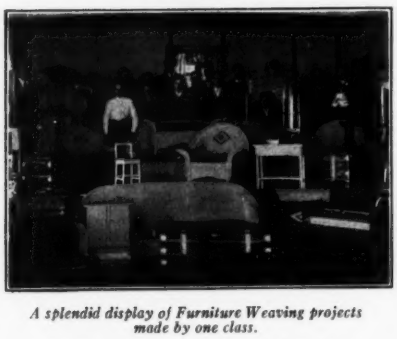

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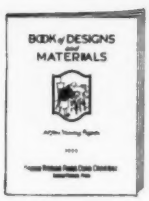

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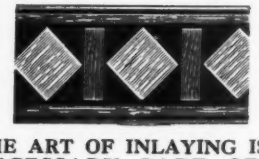

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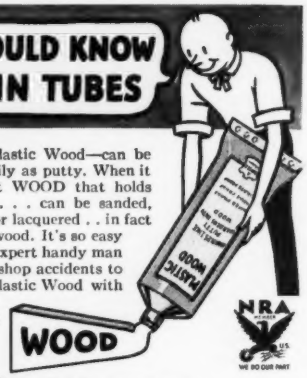

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For sources of supply on products not included in the directory, quotations or additional information to help you make up your specifications, use this form—sign, clip and mail—and we will do the rest. If you want prices or complete catalogs on items you are ready to buy, also check list on the opposite side.

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School Shop Annual Service Division

P. O. Box 2068, Milwaukee, Wis.

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